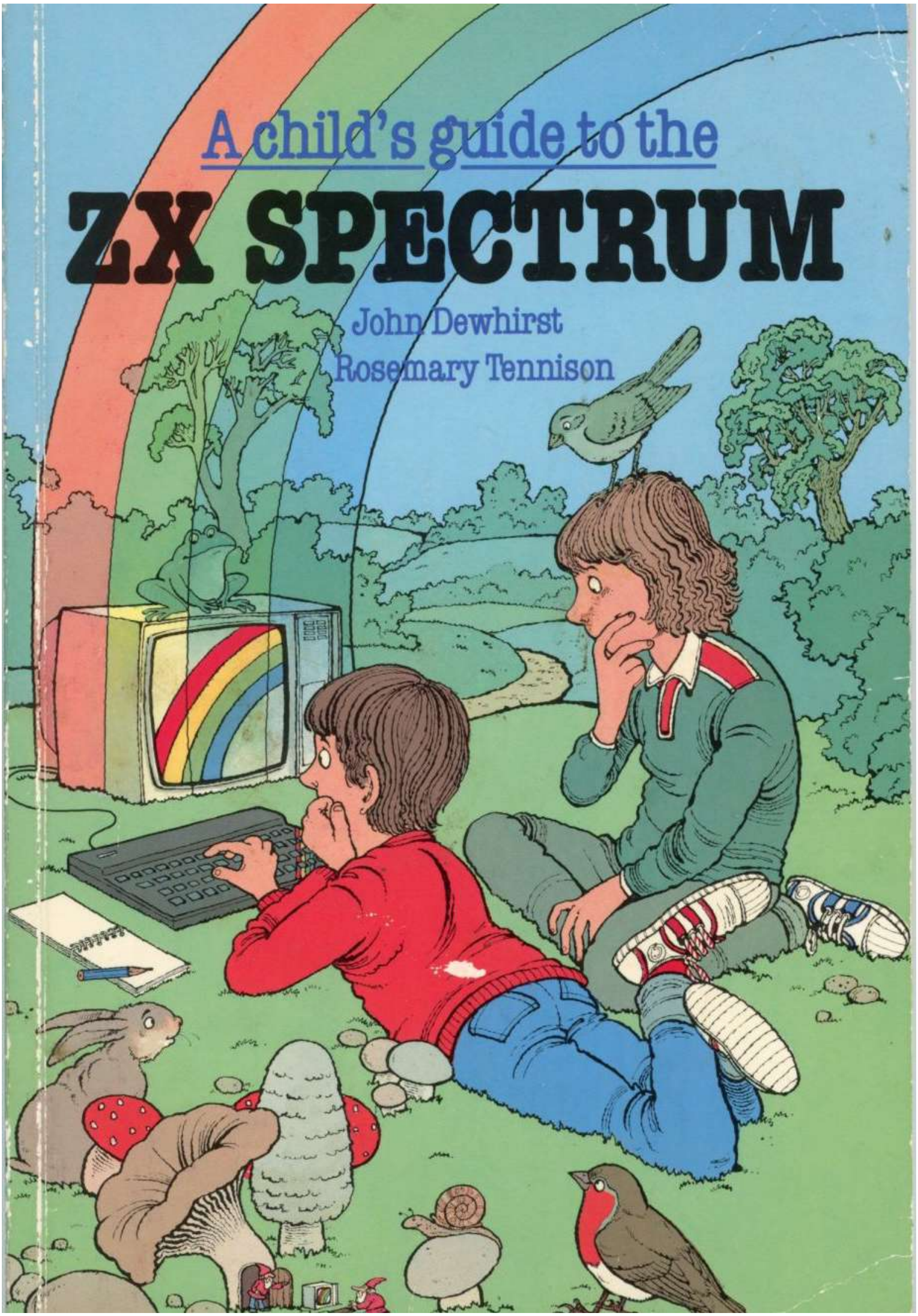
A child's guide to the

ZX SPECTRUM

John Dewhirst
Rosemary Tennison



A CHILD'S GUIDE TO THE ZX SPECTRUM

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INTRODUCTION

Each section of the book is written by a different person. Each person is an expert at his or her job and gives very useful advice. Read their advice very carefully. The advice is given at the start of each section of the book. If you follow the advice it will make the work you do much easier.

SECTIONS

1. The keyboard

by Pru Comet – typist.
Pru Comet shows you the ways in which the various types of keys work and the position of the keys on the keyboard.

2. Getting started

by P. C. Truemo – investigator.
Constable Truemo shows you how to get started on the computer, how to make it print numbers and words, calculate answers and finally store items in its memory.

3. Writing programs

by Prof. O. Crumpet – designer.
Professor O. Crumpet shows you how to copy, adapt, then finally design your own programs.

4. Special features

by Mort Puce – artist.
Mort Puce shows you how to draw coloured pictures on the screen and to make the computer play music.

5. Finding out

by Miss O. C. Termup – librarian.
Miss O. C. Termup shows you how to use the reference sections.

Mep Court,
Portcume.

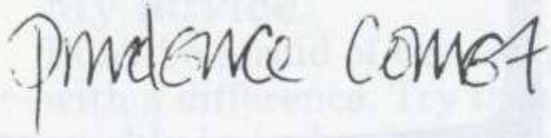
Dear Reader,

Hello there. We are the people who have written this book and you will find out more about us as you read through it. When you meet us we shall introduce ourselves.

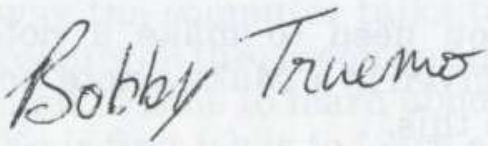
The book has been written for people who know nothing about computers, but who want to find out for themselves. It has been written to show you not just what the computer can do, but more importantly, what *you* can make the computer do for you.

We have put together all our good ideas so that it is easy for you to find out just how the ZX Spectrum works. The book is written in five sections and we have each written a section. The first four sections are to be read and worked through in order, but the last section is for reference and this can be used at any time for checking.

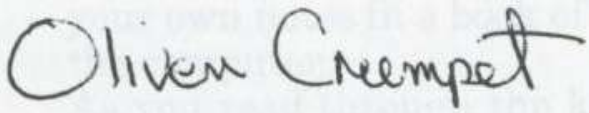
Happy computing!



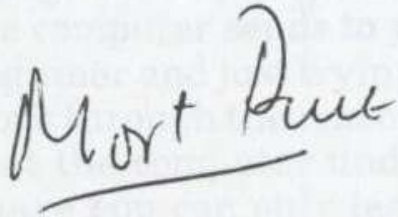
Prudence Comet



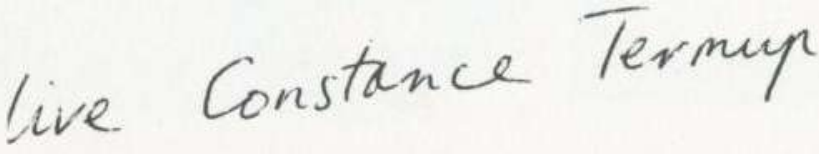
Bobby Truemo



Oliver Crumpet



Mortimer Puce



Olive Constance Termup

In each section of the book you will come across different types of diagrams. The things for you to try, that is various exercises and experiments, will all be given in a 'You try' box. The 'You try' box looks like this.

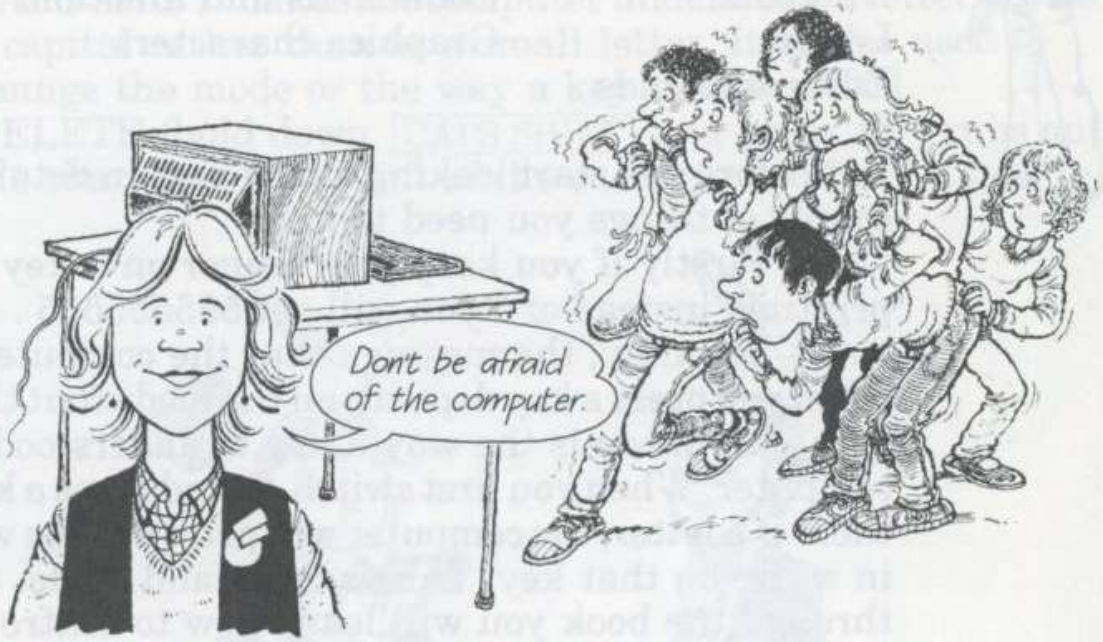
You try

The things which are displayed on the screen will all be shown in a 'Display' box. The 'Display' box looks like this.

The things which you need to make a note about and remember will all be given in a 'Make a note' box. The 'Make a note' box looks like this.

Make a note

THE KEYBOARD



Pru Comet

My advice

Don't be afraid of the computer. Think of it as a typewriter with a difference. Try things out. In this way you will learn quickly just what it can and cannot do. When you try things out, the computer will send messages back to you. This is the way the computer talks to you. It can make noises, change colours on the screen and do lots of other things, so you'll need a bit of time to learn about everything the computer can do. Your first job is to learn about the keyboard, find out where all the keys are and what they all do. A good idea is to make your own notes in a book of all the things you find out about the computer.

As you read through the keyboard section of the book, try things out as you go along. Don't be put off by any messages the computer sends to you. It does not realise that you are a beginner and just trying out a few things for yourself. As you work through the rest of the book you will learn the language that the computer understands, but like learning any language you can only learn a bit at a time.

Pru Comet.

There are 40 keys on the ZX Spectrum and their uses can be divided into the following sets.

Controls	Special symbols
Numbers	Commands and functions
Letters	Graphics characters
Edit commands	

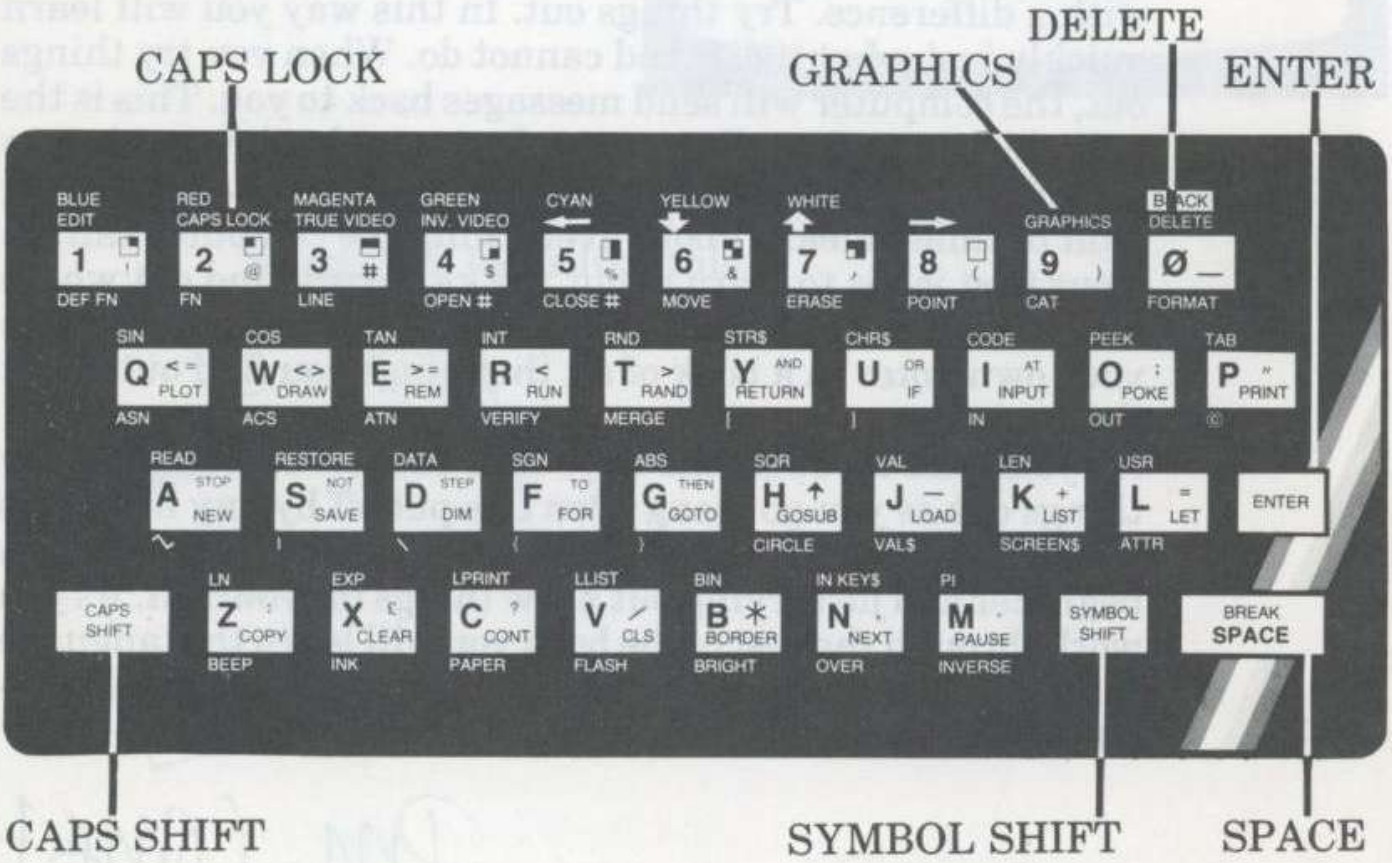
But before you start looking at the keys in detail there are a couple of things you need to know.

Firstly if you keep your finger on a key it will keep printing; instead of 5 you will get 555555555 . . . and so on.

Secondly, the message that the computer receives when you press a key depends on the mode that the computer is in. The mode is the way a key is understood by the computer. When you first switch on and press a key on which there is a letter, the computer will print out the word written in white on that key. This is command mode. As you read through the book you will learn how to control the mode. Each mode is shown by a different flashing letter, called the cursor, at the bottom of the screen. In command mode the letter is K.

Controls

There are seven control commands.



ENTER makes the computer read the line you have just typed.
SPACE moves the cursor one space to the right and so inserts a space.
CAPS SHIFT makes the computer understand a letter key as a capital rather than as a small letter. It is also used to change the mode or the way a key is understood.
DELETE (hold down [CAPS SHIFT] and press [Ø]) rubs out the character to the left of the cursor.

CAPS SHIFT

CAPS LOCK

SYMBOL SHIFT makes the computer understand a key as the word or symbol in red on the key or below it, depending on the mode the computer is in.
CAPS LOCK (hold down [CAPS SHIFT] and press [2]). When this has been pressed it is like having [CAPS SHIFT] held down all the time.
GRAPHICS (hold down [CAPS SHIFT] and press [9]). When this has been pressed, the number keys 1 to 8 produce graphics characters. You will learn more about these later in this section.

You try

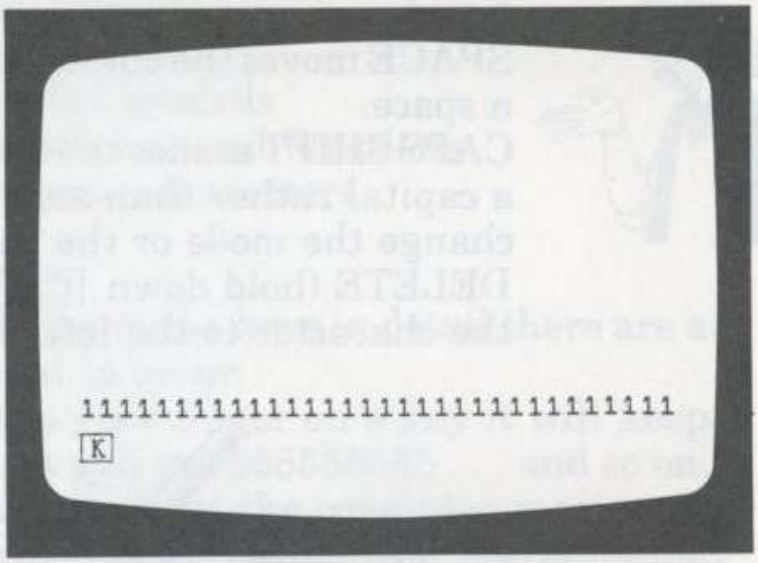
Press [SPACE] carefully three times.

This is what will appear on the screen:

You try

Hold down the number key 1 until the cursor goes onto the next line.

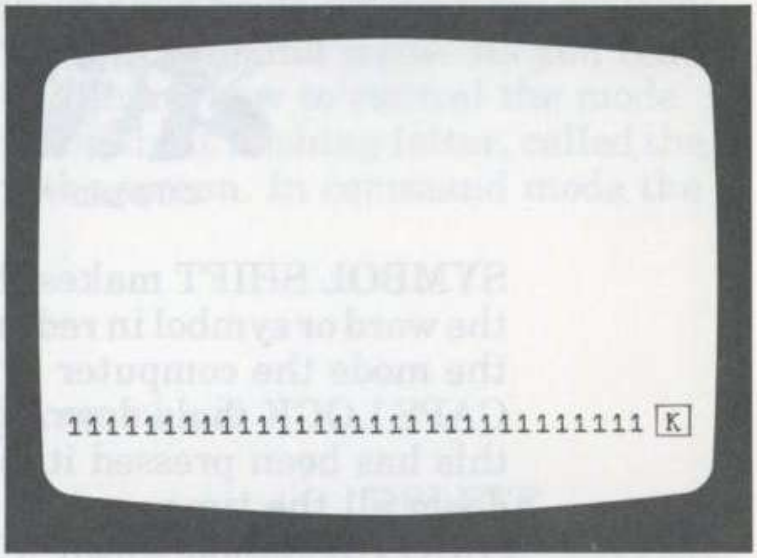
This is what will appear on the screen:



You try

Press DELETE once (hold down CAPS SHIFT and press 0).

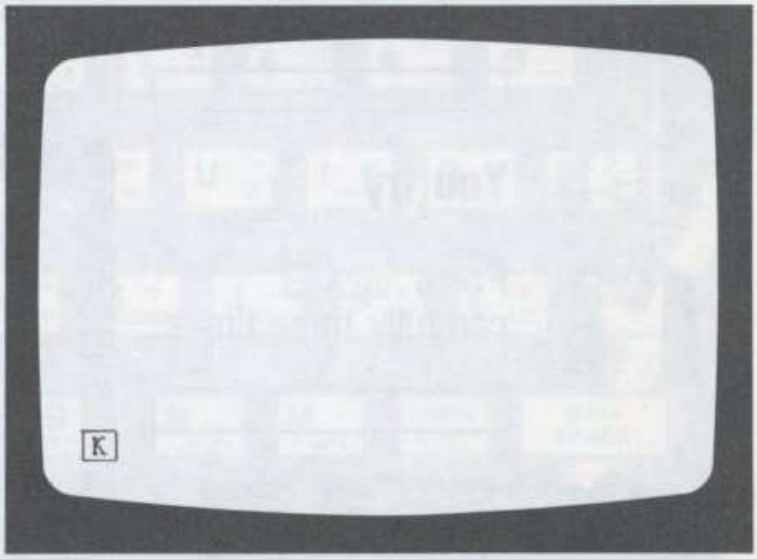
This is what will appear on the screen:



You try

Press DELETE until the cursor is back to its first position.

This is what will appear on the screen:



Make a note

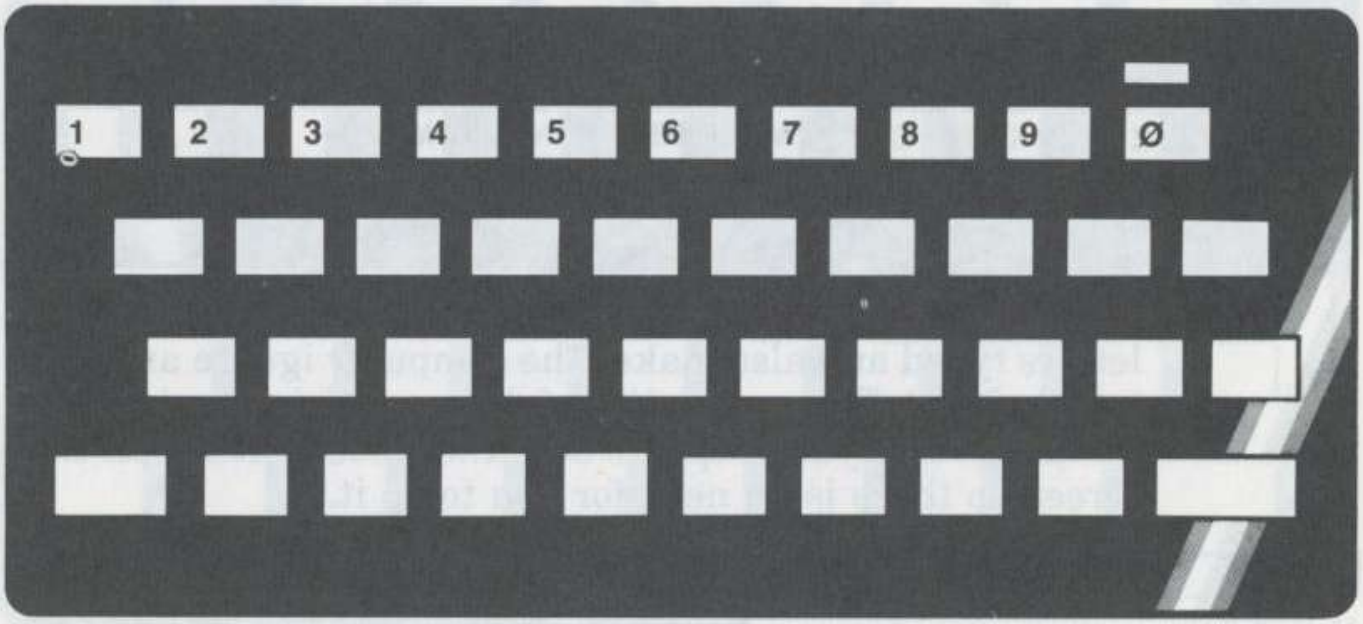
Each time DELETE is pressed the cursor moves one place to the left and rubs out any letter or number which is there.

Numbers

These are the ten keys which print the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and Ø. On the keyboard they are set out in a line:

1 2 3 4 5 6 7 8 9 Ø.

(The Ø key is used for zero so that it is not confused with the letter O.)



You try

Type out the following. Press SPACE and then press ENTER at the end of each line.

1
121
1331

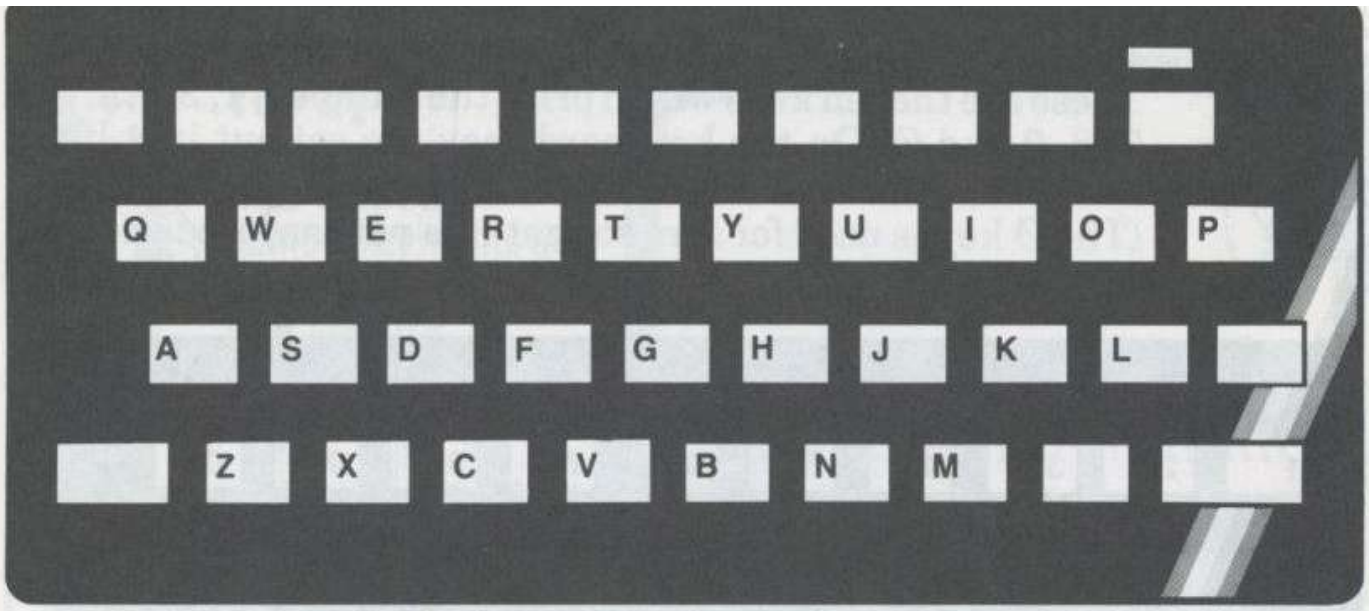
This is what will appear on the screen:

Letters

These are the 26 keys which print the letters of the alphabet A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y and Z. They are also used to print the small letters a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y and z. On the keyboard they are set out as:

Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M

which is exactly the same as you would find them on a typewriter.



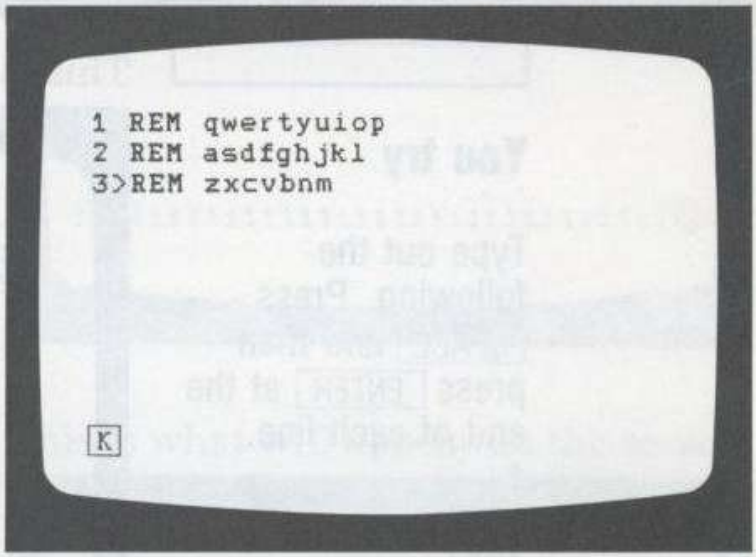
The word REM on key [E] makes the computer display the letters typed and also makes the computer ignore anything typed after it. This makes it useful for practising typing. The computer will put in spaces on either side of REM on the screen so there is no need for you to do it.

You try

Type out the following. Press [ENTER] at the end of each line. Remember that [REM] is to be found on the key [E].

1 [REM] qwertyuiop
2 [REM] asdfghjkl
3 [REM] zxcvbnm

This is what will appear on the screen:

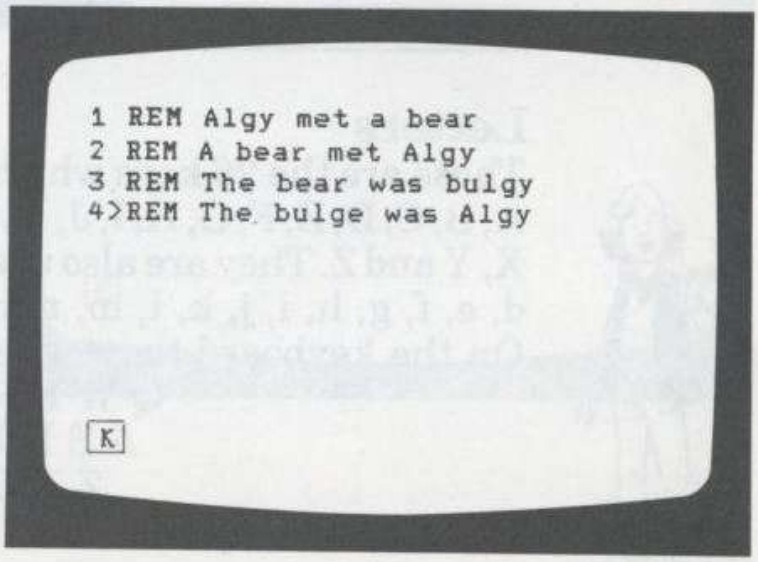


You try

Type out the following. Press [ENTER] at the end of each line. Hold down [CAPS SHIFT] when you want a key to print a capital letter.

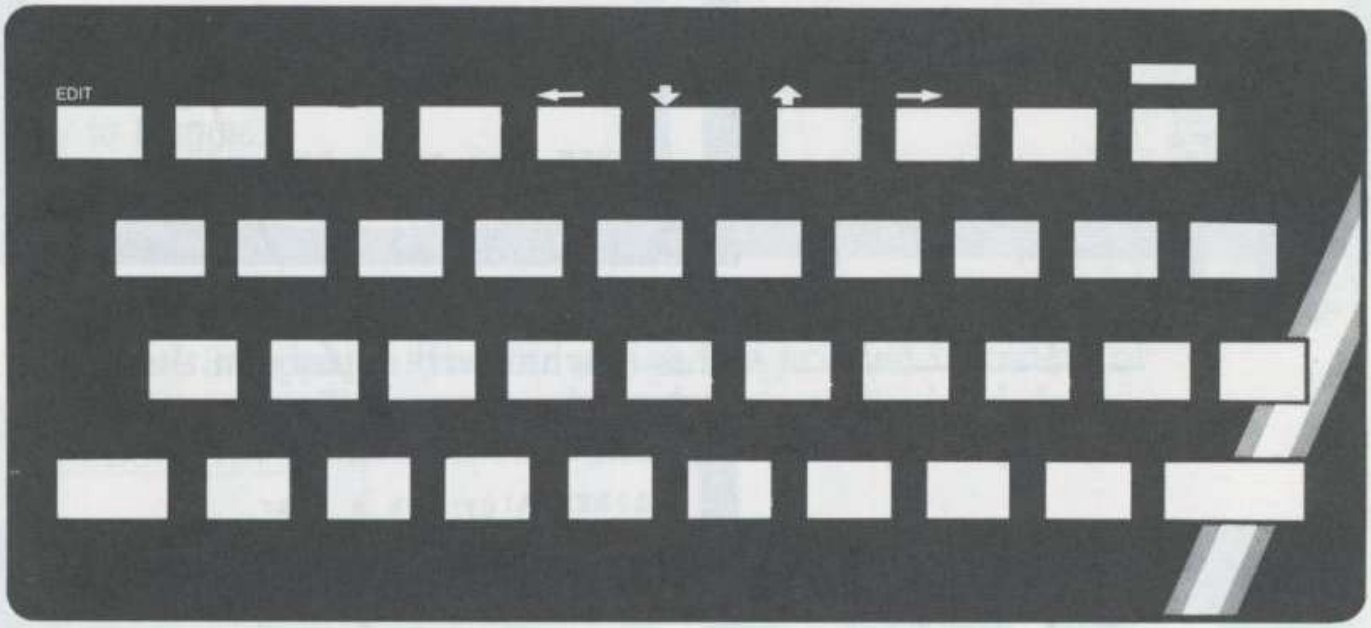
1 [REM] Algy met a bear
2 [REM] A bear met Algy
3 [REM] The bear was bulgy
4 [REM] The bulge was Algy

This is what will appear on the screen:



Edit commands

The five edit commands are on the number keys 1, 5, 6, 7 and 8. Four of the keys have arrow signs which point up, down, right and left and the other edit command is EDIT. To operate the edit commands hold down CAPS SHIFT and press the number key with the command you want above it.



The up and down arrows enable you to choose a line you wish to change.

This is what will appear on the screen:

```
1>REM Algy met a bear
2 REM A bear met Algy
3 REM The bear was bulgy
4 REM The bulge was Algy

K
```

You try

Do the previous 'You try' so that the poem about Algy is on the screen. Press the up arrow key three times (hold down CAPS SHIFT and press 7).

The pointer has moved to line 1 which is the line we wish to change.

This is what will appear on the screen:

```
1>REM Algy met a bear
2 REM A bear met Algy
3 REM The bear was bulgy
4 REM The bulge was Algy


1K REM Algy met a bear
```

You try

Press [EDIT] (hold down [CAPS SHIFT] and press [1]).

This is what will appear on the screen:

```
1>REM Algy met a bear
2 REM A bear met Algy
3 REM The bear was bulgy
4 REM The bulge was Algy


1 REM Algy met a bear L
```

You try

Press the right arrow key 16 times (hold down [CAPS SHIFT] and press [8]).

This is what will appear on the screen:

```
1>REM Algy met a bear
2 REM A bear met Algy
3 REM The bear was bulgy
4 REM The bulge was Algy


1 REM Algy met a L
```

You try

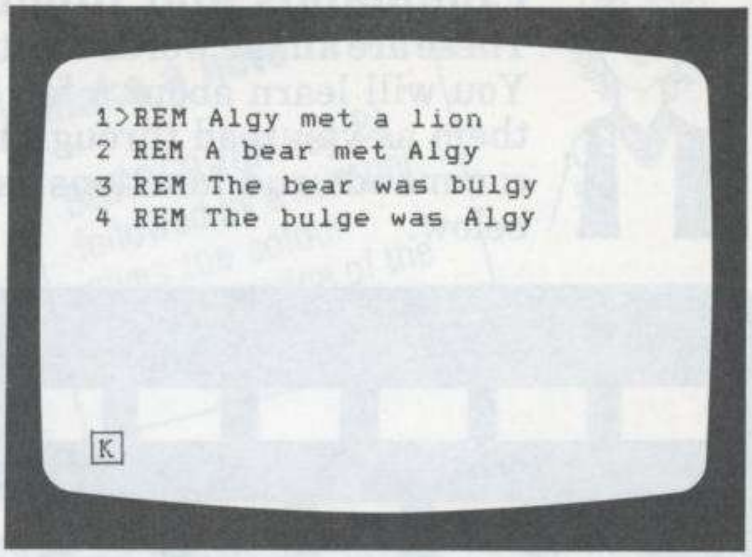
Press [DELETE] four times (hold down [CAPS SHIFT] and press [0]).

You try

Type the word 'lion' and then press ENTER.

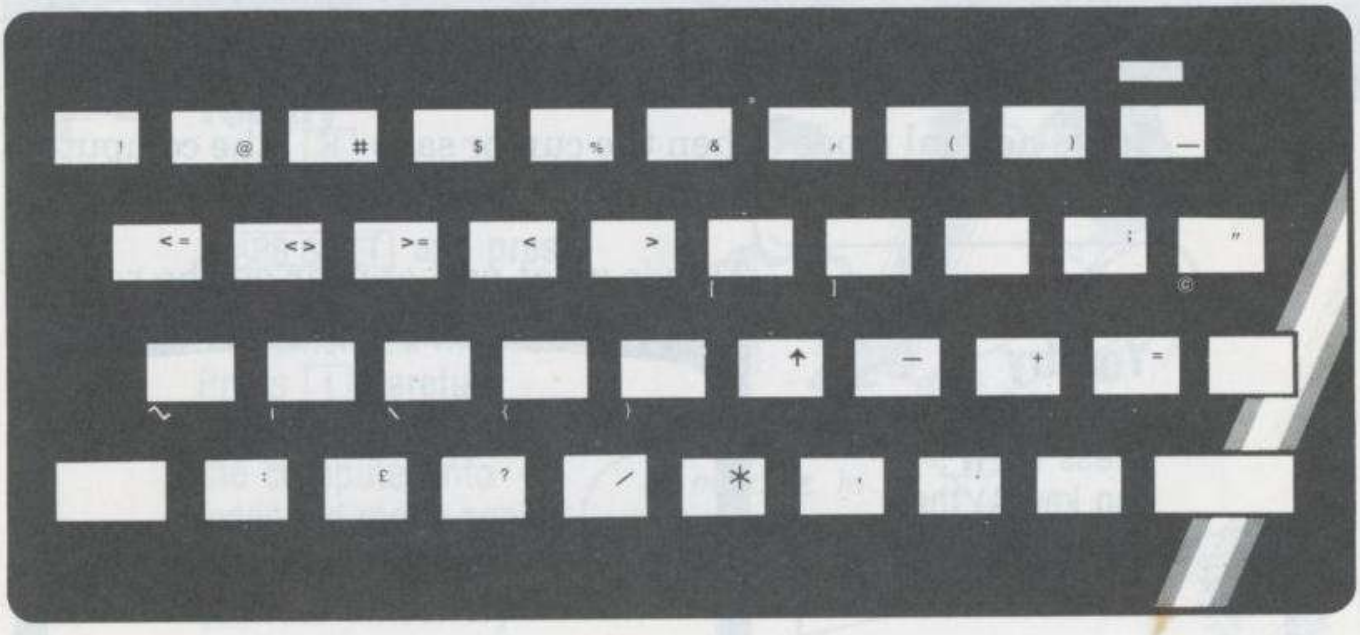
Use the edit keys to change bear to lion in lines 2 and 3. Change Algy to Maggie.

This is what will appear on the screen:



Special symbols

There are 36 special symbols which are printed in red on or below the keys. To type a red symbol on a key hold down SYMBOL SHIFT (also in red) and then press the key.



You try

Type out the following. Press ENTER at the end of each line.

1 REM punctuation ! " ' ; : , . ?
2 REM arithmetic + − * / % =
3 REM inequalities <= <> >= < >
4 REM other $ £ & @

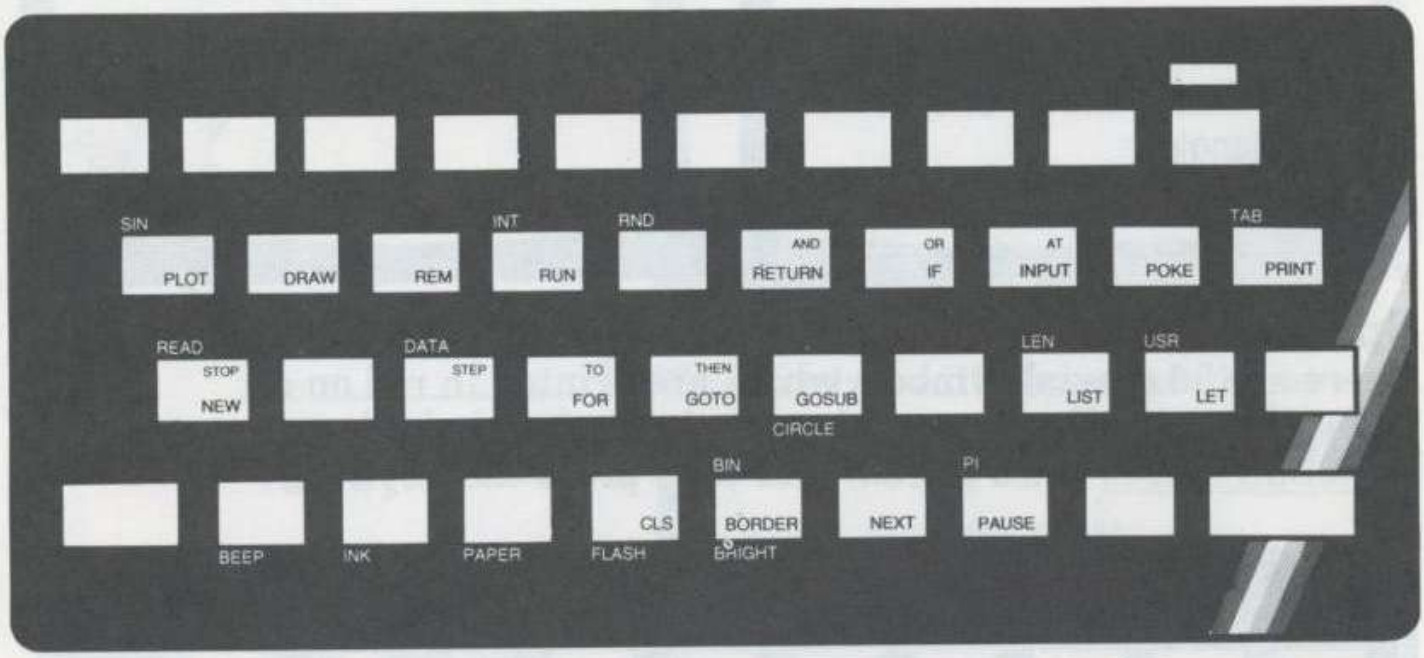
You try

Type out the following. Press ENTER at the end of each line.

1 REM !
2 REM @
3 REM #
4 REM $
5 REM %
6 REM &
7 REM '
8 REM (
9 REM)

Commands and functions

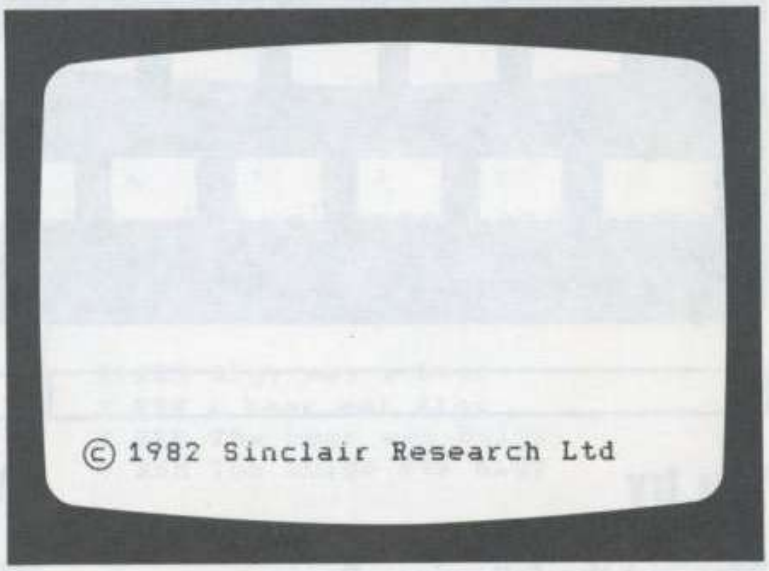
These are all the words written on, above and below the keys. You will learn about a few of them now and about more of them as you read through the book. To help you, the commands and functions explained in this book are shown below.



In its normal mode (when the cursor says [K]) the computer reads the word printed in white on the key pressed.

[ ]

This is what will appear on the screen:



You try

Press [NEW] (on key A) then press [ENTER].

[ ]

Make a note

NEW is on key A and resets the computer as if it has just been switched on.

You try

Press BORDER (on key B), then press 1 followed by ENTER. Try pressing BORDER followed by other numbers.

Make a note

BORDER (on key B) followed by a number gives the colour round the edge of the screen.

To obtain the commands and functions given above and below the keys you need to change mode. To do this hold down CAPS SHIFT and press SYMBOL SHIFT. The cursor will change to E to show that the computer is in extended mode. The computer will now read the words given above the keys.

You try

Hold down CAPS SHIFT and press SYMBOL SHIFT to go into extended mode. Press 1 carefully four times. Now put the computer into extended mode again and this time press 2 four times. Try putting the computer into extended mode (with the cursor showing E) and pressing the number keys 3, 4, 5, 6, 7 and Ø.

Make a note

To read the words above the keys go into extended mode by holding down CAPS SHIFT and pressing SYMBOL SHIFT. The computer goes back to its normal mode (with the cursor showing K) after one key press. To read the words below the keys put the computer into extended mode then hold down SYMBOL SHIFT and press the key.

To clear the screen after the last 'You try' press EDIT (hold down CAPS SHIFT and press 1).

You try

Hold down CAPS SHIFT and press SYMBOL SHIFT to put the computer in extended mode, then hold down SYMBOL SHIFT and press X to give the word 'INK'. Now type 5 and press ENTER.
Type out the following.
1 REM INK is writing colour
Put the computer into extended mode. Hold down SYMBOL SHIFT and press C to give the word 'PAPER'.
Now type 6 and press ENTER. Type out the following.
2 REM PAPER is screen colour

Make a note

To read the word in red below a key go into extended mode by holding down CAPS SHIFT and pressing SYMBOL SHIFT.

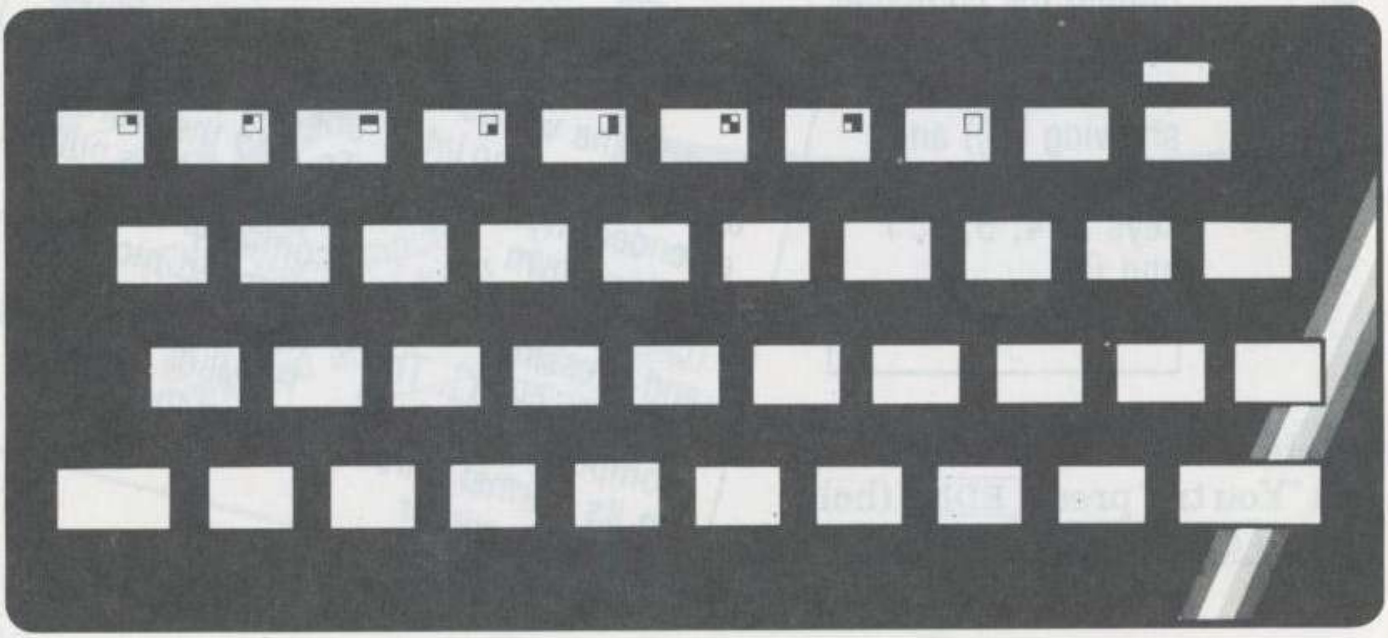
Then hold down SYMBOL SHIFT and press the key. The computer goes back to its normal mode after one key press.

You try

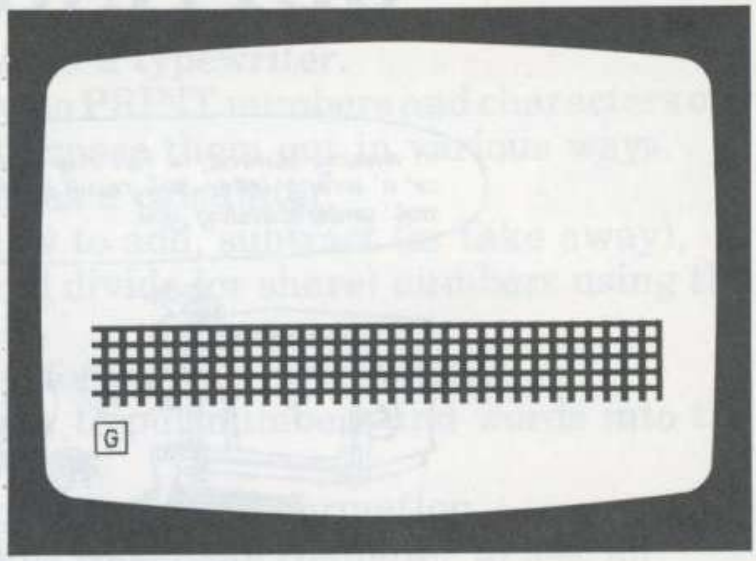
Use the commands BORDER, INK and PAPER to make different colours on the screen.

Graphics characters

There are 8 graphics characters which are in white on the number keys 1 to 8. To make the computer display them, first go into graphics mode by holding down CAPS SHIFT and pressing 9. The cursor will then change to a flashing G.



This is what will appear on the screen:

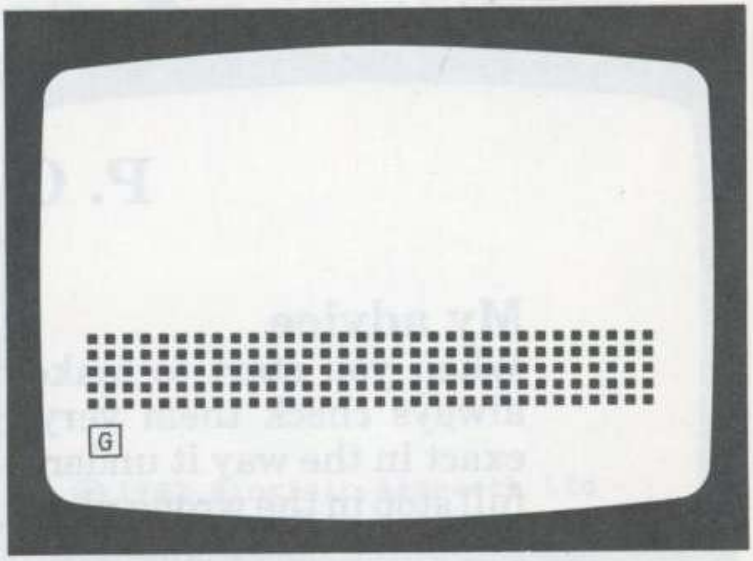


You try

Hold down CAPS SHIFT and press 9 to go into graphics mode. Then hold down key 7 until five lines have been filled.

Now press 9 to leave graphics mode then press EDIT (hold down CAPS SHIFT and press 1) to clear the screen.

This is what will appear on the screen:



You try

Use EDIT to clear the screen, then go into graphics mode. Hold down CAPS SHIFT and press 7 until five lines have been filled.

You try

Go into graphics mode and make other patterns by pressing the number keys.

You try

Make patterns with the other graphics characters while holding down CAPS SHIFT.

You try

Use graphics characters to make a picture of a castle, a boat or a train. If you also use extended mode and the number keys you can add colour.

P. C. Truemo

My advice

When you start to make the computer do things for you always check them very carefully. The computer is very exact in the way it understands things. A missing comma, a full stop in the wrong place or a wrong letter will result in the computer not understanding you.

When this happens – INVESTIGATE. Track down every possible mistake until you get everything correct. It may take some time at first to track down your mistakes, but gradually you will not only become quicker at doing this, but you will also make fewer mistakes.

Make notes of the things you find useful, so that you can use them again easily whenever you want. Finally, I find these points very useful.

1. Select the right mode before you press a key.
2. Remember: after every instruction, press ENTER.

Bobby Truemo

In this section you will be shown how to use the computer in four different ways.

1 Using the computer as a typewriter.
You will be shown how to PRINT numbers and characters on the screen and how to space them out in various ways.

2 Using the computer as a calculator.
You will be shown how to add, subtract (or take away), multiply (or times) and divide (or share) numbers using the computer.

3 Using the computer for storing information.
You will be shown how to put numbers and words into the memory of the computer.

4 Using the computer to ask for information.
You will be shown how to get the computer to ask for information, which it then puts into its memory.

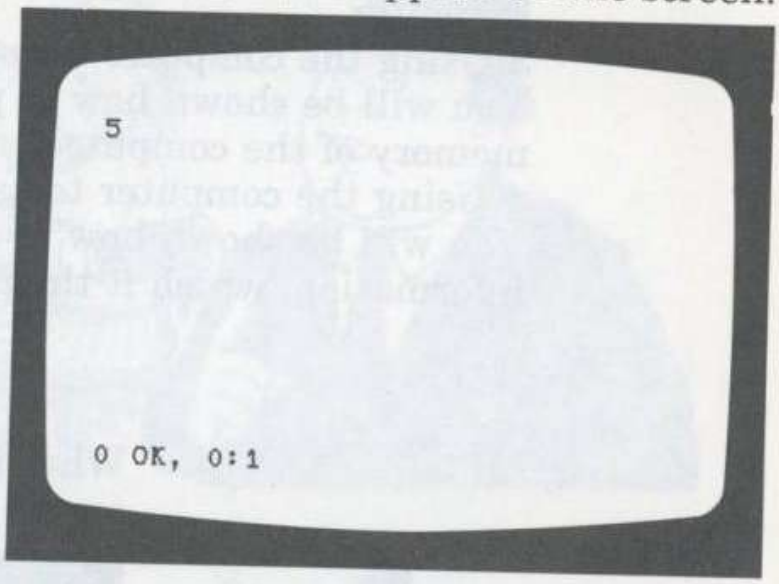
When switched on this is what appears on the screen of the ZX Spectrum.

The computer as a typewriter

To make the computer write things we use PRINT. PRINT is on key P.

Printing numbers

This is what will appear on the screen:



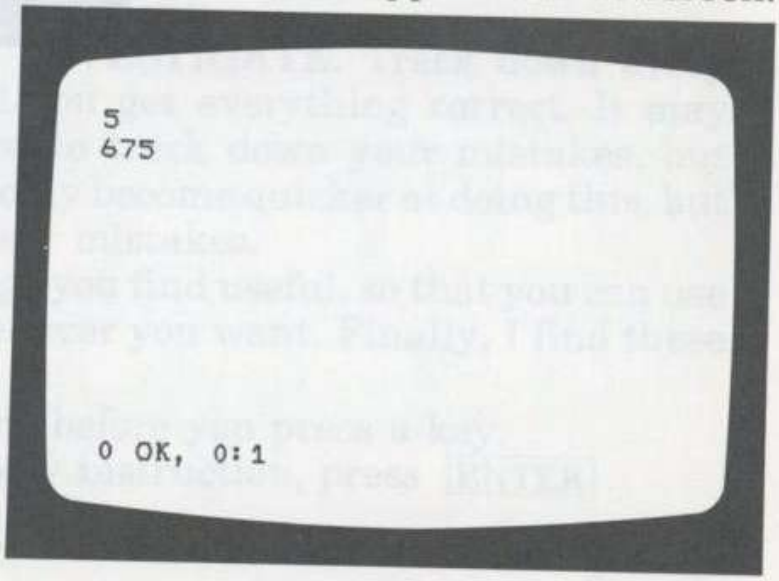
You try

Press PRINT, type 5 then press ENTER.

Make a note

PRINT is on key P. To print a number press PRINT followed by the number and then press ENTER.

This is what will appear on the screen:



You try

Type PRINT 675 then press ENTER.

You try

Using the same idea PRINT some numbers of your own.

Printing symbols, letters and words

This is what will appear on the screen:

You try

Type PRINT "?" then press ENTER.

Make a note

To print a symbol, letter or word, press PRINT followed by the symbol, letter or word inside speech marks, then press ENTER.
Remember that if you wish to start again with a clear screen you can press NEW.
The screens in the book show the new writing which appears.

This is what will appear on the screen:

You try

Type PRINT "bee" then press ENTER.

You try

Use PRINT to make the computer write your name

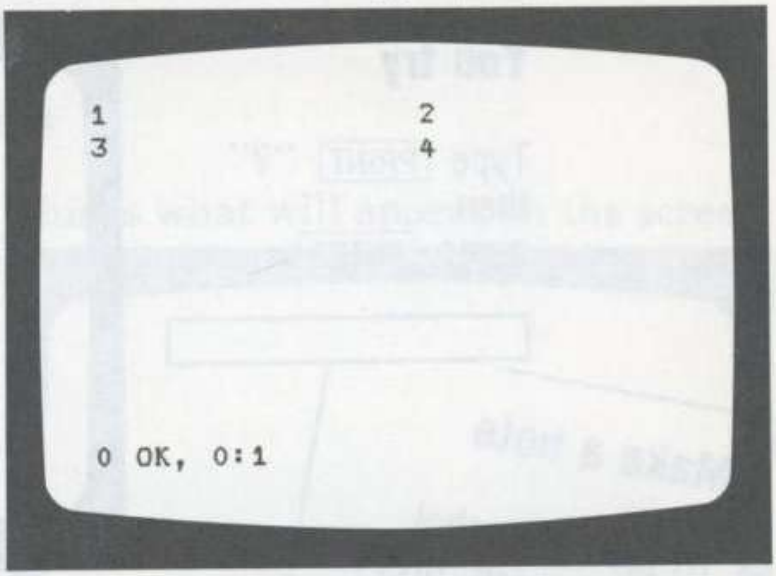
Spacing numbers

You try

Type PRINT 1,2,3,4 then press ENTER.

Don't stand and wait, INVESTIGATE.

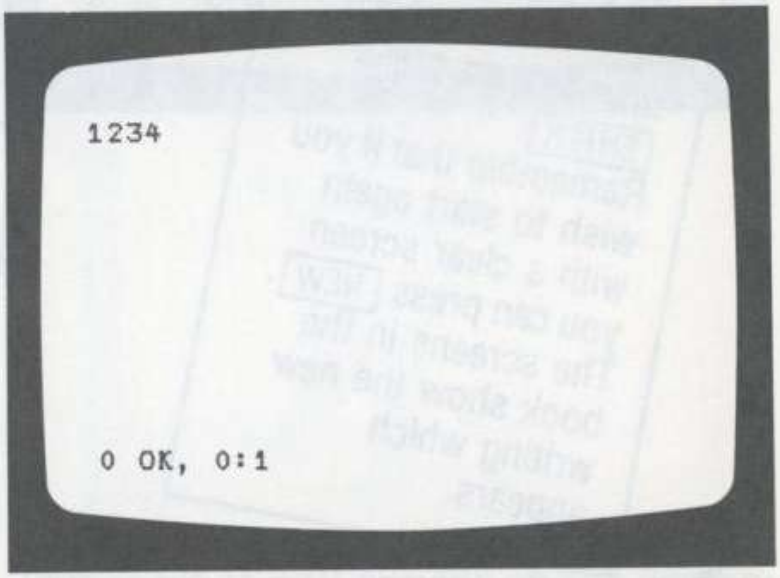
This is what will appear on the screen:



You try

Type PRINT 1;2;3;4 then press ENTER.

This is what will appear on the screen:



Make a note

The symbol
, prints spaced out
; prints without spaces
' prints on two lines

You try

Type PRINT 12'34 then press ENTER.

Using the same ideas space out some numbers of your own.

This is what will appear on the screen:

Spacing words

This is what will appear on the screen:

You try

Type
PRINT "dog", "cat"
then press ENTER.

```
dog             cat

0 OK, 0:1
```

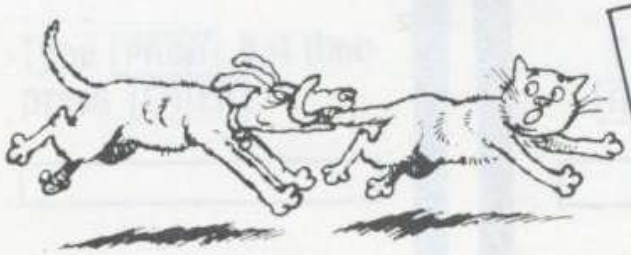
This is what will appear on the screen:

You try

Type
PRINT "dog"; "cat"
then press ENTER.

```
dogcat

0 OK, 0:1
```



Make a note

The symbol
, prints words spaced out
; prints words without spaces
' prints words on two lines

This is what will appear on the screen:

You try

Type
PRINT "dog" ' "cat"
then press ENTER.

You try

Using the same idea space out your first and second names.

The computer as a calculator

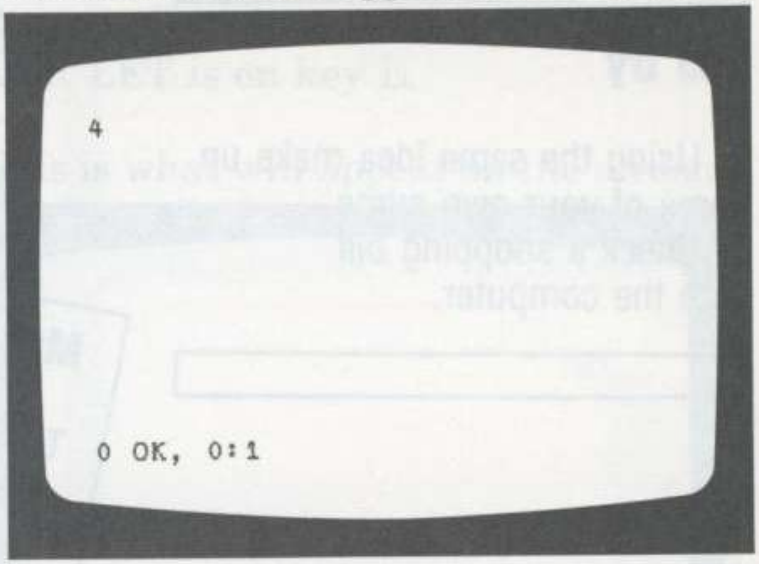
The PRINT statement can also be used to make the computer act like a calculator. It can be given a question and it will supply the answer.

This is what will appear on the screen:

You try

Type PRINT 5+7
then press ENTER.

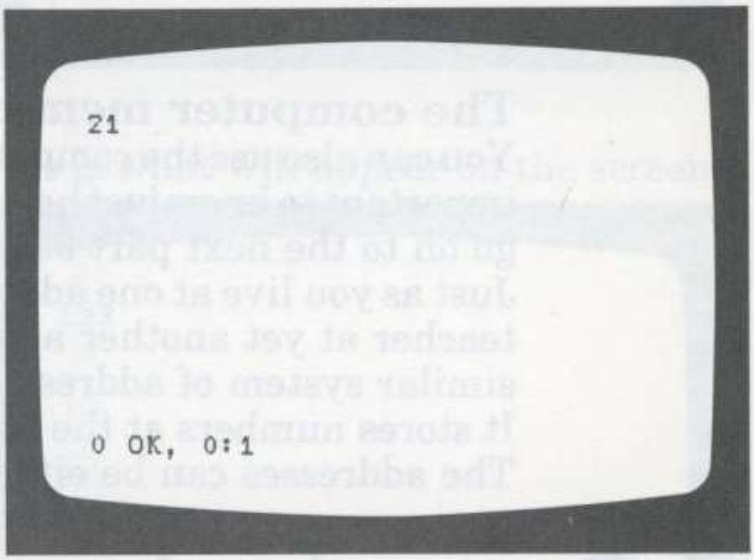
This is what will appear on the screen:



You try

Type PRINT 8−4 then press ENTER.

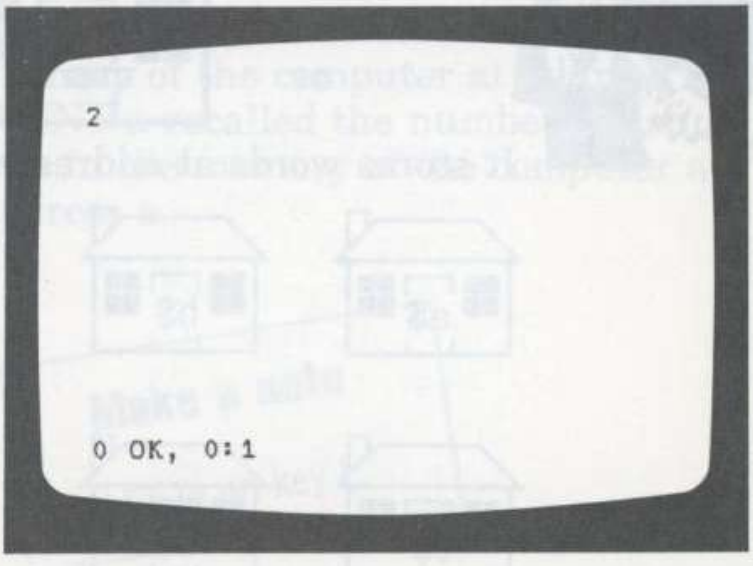
This is what will appear on the screen:



You try

Type PRINT 7*3 then press ENTER.

This is what will appear on the screen:



You try

Type PRINT 8/4 then press ENTER.

You try

1. Using the same idea make up some of your own sums.
2. Check a shopping bill with the computer.

Make a note

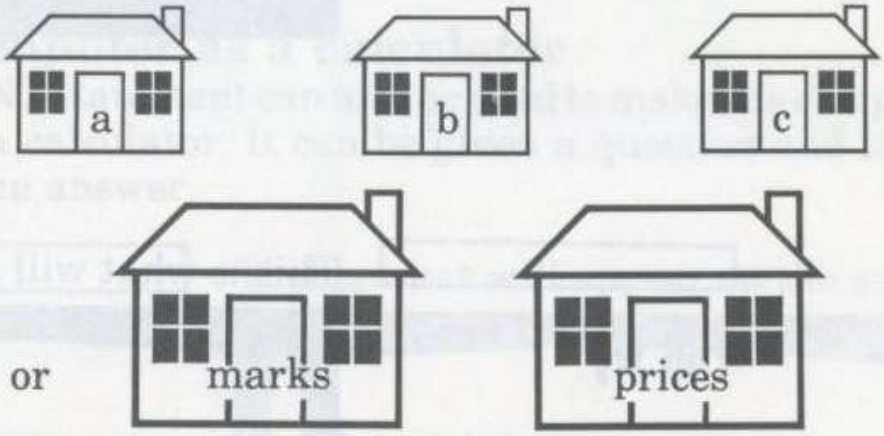
The symbols used are
+ add
− subtract (or take away)
* multiply (or times)
/ divide (or share)

The computer memory

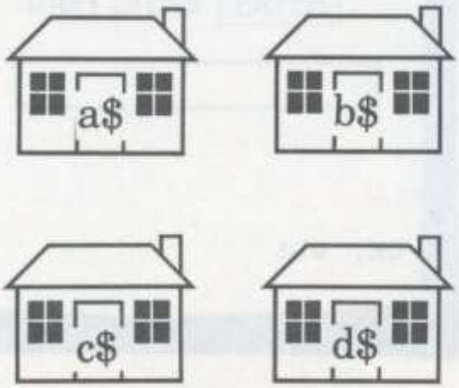
You can also use the computer to remember information. It is important to know just how the computer does this before you go on to the next part of this section.

Just as you live at one address, your friend at another, your teacher at yet another address, so the computer uses a similar system of addresses for storing information.

It stores numbers at the following addresses in its memory. The addresses can be either letters or words. For example



It stores words at addresses like these.



Make a note

The computer uses a, b, c, d etc. for addresses to store numbers and uses a$, b$, c$, d$ etc. for addresses to store words.

You try

Type in a number, for example 9, then press ENTER. You may need to add more spaces to make the words look right.

You try

This program can be turned into a game by leaving unchanged lines 2Ø, 3Ø, 4Ø, 1ØØ, 11Ø, 13Ø and 14Ø and typing in the following lines.

1Ø LET n= INT (3Ø* RND)
5Ø INPUT "What is my number?";d
6Ø PRINT "My number is ";n
7Ø STOP
12Ø PRINT "my number is shared by ";m;

Type RAND (on key T) then ENTER.
Type RUN then ENTER.
Try to guess the number.
You may like to change the program so that it checks whether you have guessed the right number and prints 'right' or 'wrong'.

This is what will appear on the screen:

```
The remainder when 9 is shared
by 2 is 1
The remainder when 9 is shared
by 3 is 0
The remainder when 9 is shared
by 5 is 4


9 STOP statement, 50:1
```

You try

Press NEW then ENTER.
Type in the following program.

```
1ØØ LET j$="went to mow "
11Ø LET k$=j$+"a meadow "
12Ø LET i$="one man "
13Ø GOSUB 1ØØØ
14Ø GOSUB 2ØØØ
15Ø PRINT
16Ø LET i$="two men "
17Ø GOSUB 1ØØØ
18Ø LET i$=i$+", one man "
19Ø GOSUB 2ØØØ
2ØØ STOP
1ØØØ REM first line subroutine
1Ø1Ø PRINT i$+j$+", "+k$
1Ø2Ø PRINT
1Ø3Ø RETURN
2ØØØ REM second line subroutine
2Ø1Ø PRINT i$+"and his dog "+k$
2Ø2Ø PRINT
2Ø3Ø RETURN
```

Press RUN then ENTER.
Add a few lines to the program so that it will print out a third verse as well.

Project 1 – Knock, knock

The aim of this program is to make the computer tell knock, knock jokes. First it is necessary to set up some starting values and give some data. The main steps are given below.

1. LET count=Ø (We are going to count the number of jokes so that we know when we have reached the end. This is to start the count. We shall increase the count by one each time a joke is told.)
LET jokes=6 (This gives the number of jokes the computer can tell.)
The data for this program can be entered as DATA "Ivor", "sore hand from knocking on your door", "Howard", "I know", "Mr", "last bus home", "Amos", "quito", "Lettuce", "in and you'll find out", "Ken", "I come in".

2. Now we can set up the main part of the program. The computer should be made to

(**a**) ask if you want to hear a knock, knock joke;
(**b**) INPUT the answer;
(**c**) if the answer is 'no' then STOP;
(**d**) READ n$,l$ (name and last line);
(**e**) PRINT "Knock, knock"
"Who's there?"
n$
n$+" who?"
n$;l$
(This will take several PRINT statements.)
(**f**) LET count=count+1 (increasing count by one);
(**g**) IF count <6 THEN go to part (a) (so that the next joke is told).

Improvements and variations

A. Add some more jokes.
B. Make the telling of the jokes into a conversation with the computer. Then the computer will PRINT "Knock, knock", you will INPUT "Who's there?", etc.
C. Make the program STOP if the answer to 'Do you want to hear another joke?' is 'no' or 'NO' or 'No'.
D. Make the computer PRINT a message when it has run out of jokes to tell.
E. Include a pause between telling one joke and asking if you wish to hear another. This can be done by inserting the line PAUSE 2ØØ (PAUSE is on key M). A larger number after PAUSE will make the pause longer.

Project 2 – Countdown

In this project you will program the computer to play a game with you. In the game you start with 20 counters. You and the computer take it in turns to remove 1, 2, 3 or 4 counters. The one to remove the last counters so that none are left is the winner. The program can be written as follows.

1. Make the computer explain the game using PRINT.

2. Set up the numbers of counters to be 2Ø.

3. Have your turn which consists of the following steps.

(**a**) Make the computer ask for the number of counters you wish to remove and INPUT the answer.

(**b**) Take away your answer from the number of counters to give the number of counters remaining and PRINT the result.

(**c**) Check whether the number of counters is zero. If it is then make the computer tell you that you have won and STOP the game.

4. Make the computer have a turn by doing the following steps.

(**a**) If the number of counters is less than five (<5), then the computer can choose to remove all the counters. If the number of counters is greater than or equal to 5 (>=5) then the computer chooses to remove a random number of counters between 1 and 4 (use 1+INT(RND*4). (Use IF/THEN twice for this part.)

(**b**) Calculate the new number of counters and PRINT the result.

(**c**) Check whether the number of counters is zero. If it is then the computer says that it has won and STOPs the game, otherwise it returns to your turn (step 3). Make sure that the name for the number of counters is the same as at the beginning of step 3.

Improvements and variations

A. The computer could ask whether you want the first turn, and if not have the first turn itself.

B. Instead of having the computer write down the number of counters, make it draw the counters (use PRINT and the letter O as a counter).

C. Make the screen clearer by using CLS, PRINT on its own for a blank line, and extra spaces.

D. It would be a good idea to make the computer check that you are not cheating by trying to remove too many counters or none at all.
E. You could vary the number of counters at the start and the number which may be picked up at each turn.
F. When you have played the game a few times and know how to beat the computer, try making the computer play more intelligently.

Project 3 – Lions and antelopes

The purpose of this program is to set up a situation like the one faced by the warden of a game park in Africa. We shall look at the lions and antelopes in the game park. The lions kill the antelopes for food (about 2ØØ each in a year), and the warden has to choose how many lions to kill to keep the numbers under control.
The structure of the program is as follows.

1. Make the computer explain the situation for someone new coming to the program, using PRINT.

2. Give starting values for the number of lions and the number of antelopes. It is sensible to start with about 15 lions and 1ØØØØ antelopes.

3. Make the computer ask for the number of lions to be killed this year and INPUT the reply. This number is called the cull.

4. Work out the number of lions and antelopes for the following year using the equations below.

```
LET lions=INT(lions-cull +
  lions*(antelopes-4ØØ*lions)/1ØØØØ)
LET antelopes=INT(antelopes-2ØØ*lions +
  antelopes*(2ØØØØ-antelopes)/3ØØØØ)
```

INT makes sure that the answer is a whole number. The equation for the lions says that the new number of lions is the number from the previous year, minus the number killed, plus a number of births and deaths depending on the number of lions available to breed and the number of antelopes available as food. The equation for the antelopes is the number from the previous year, minus the number killed by lions, plus the number of births and deaths. Make the computer PRINT the new number of lions and antelopes.

5. Make the computer ask if you want another go, and if so then go to step 3.

Improvements and variations

A. Alter the number of lions and antelopes at the start either by using INPUT so that the user chooses them, or by using RND so that the computer chooses them.

B. Make the computer keep a count of the year and PRINT the year number each time round. The computer could then ask if you wish to continue after every ten years, instead of every year.

C. Include a check that the number of lions and the number of antelopes do not become negative.

D. Include messages of congratulations if the number of lions and antelopes become large and scold the user if they become small.

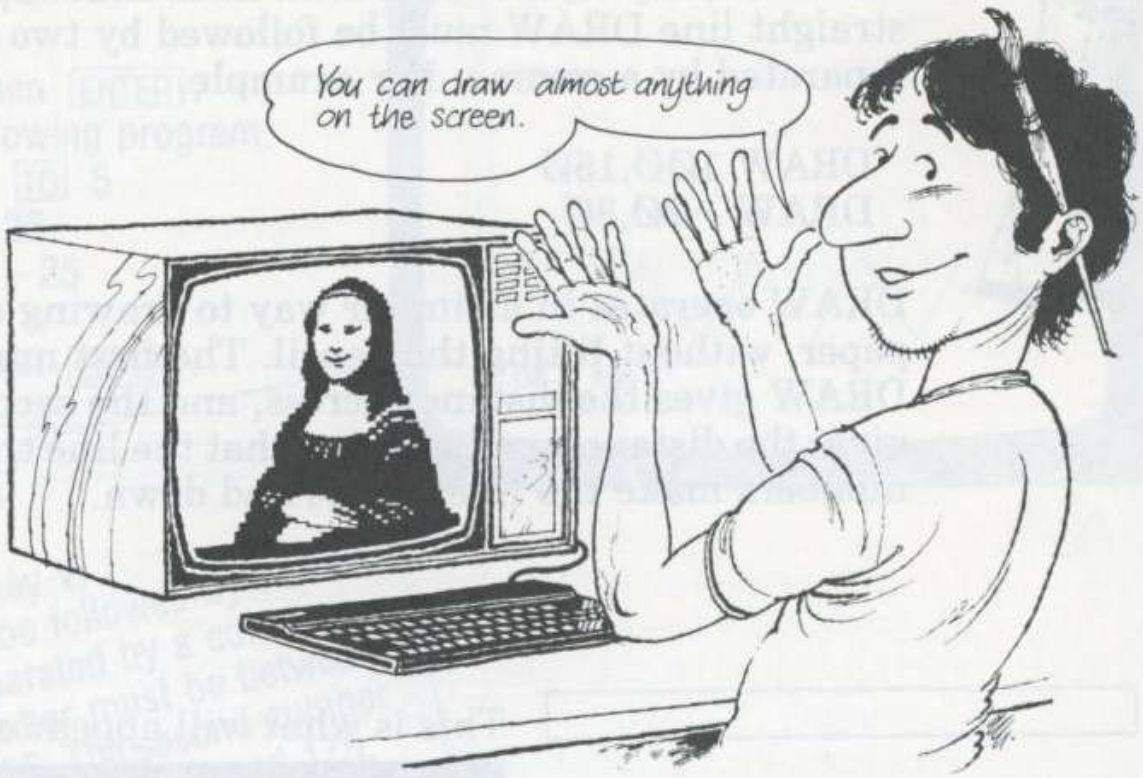
E. Make the writing on the screen clearer by using CLS (to clear the screen), PRINT on its own (to give a blank line), and put in extra spaces between words so that no words are split between lines.

F. If you feel ambitious you could try drawing a picture of the park, and using symbols for lions and antelopes (say one symbol to represent a lion and another to represent 1ØØ antelopes). You will be able to do this better after reading the next chapter.

Other ideas for computer programs

1. A game of chance which uses random (RND) numbers
2. A spelling test
3. A list of questions on a particular subject
4. A musical scale
5. A questionnaire
6. A coloured diagram
7. A science experiment
8. A clock
9. A cash register
10. An anagram finder
11. A language translator
12. A passage in which missing words have to be filled in
13. A pattern designer
14. A list of names and addresses
15. A plan or scale drawing
16. A word game
17. An alphabetical sorter
18. A number game with questions and answers
19. A foreign money exchange
20. A cartoon
21. A maze
22. A rocket launcher
23. A TV advert
24. A guessing game
25. A tune

You may need to look back at some of the programs in the book or ones which you have written yourself.
It may also be helpful to check certain things in the reference sections from time to time. Some of the programs you will find easier after you have looked at the next chapter.



Mort Puce

My advice

My advice is to look at new commands carefully. When you think you understand the idea, experiment and try things out. You will learn what looks right. Of course, when you work like this you may create a mess. Don't be put off: try again. Remember your successes and forget about your failures.

Try out all the ideas you can think of. Explore lines, angles, shapes, colours and even music. You can draw almost anything on the screen and colour it in different ways and then to celebrate your masterpiece compose a tune.

When you hit on a good idea make sure you write some notes about it, so that you will be able to use the idea again.

Mortimer Puce

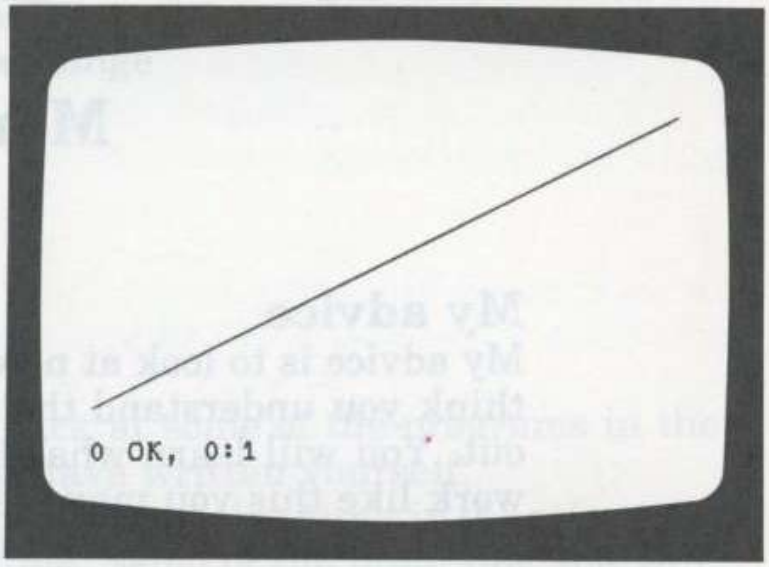
Drawing on the screen

DRAW (on key W) is used to draw lines and shapes. To draw a straight line DRAW must be followed by two numbers separated by a comma. For example,

```
DRAW 1ØØ,15Ø
DRAW -2Ø,3Ø
```

DRAW operates in a similar way to drawing on a piece of paper, without lifting the pencil. The first number after DRAW gives the distance across, and the second number gives the distance up the screen that the line travels. Minus numbers make the line go left and down.

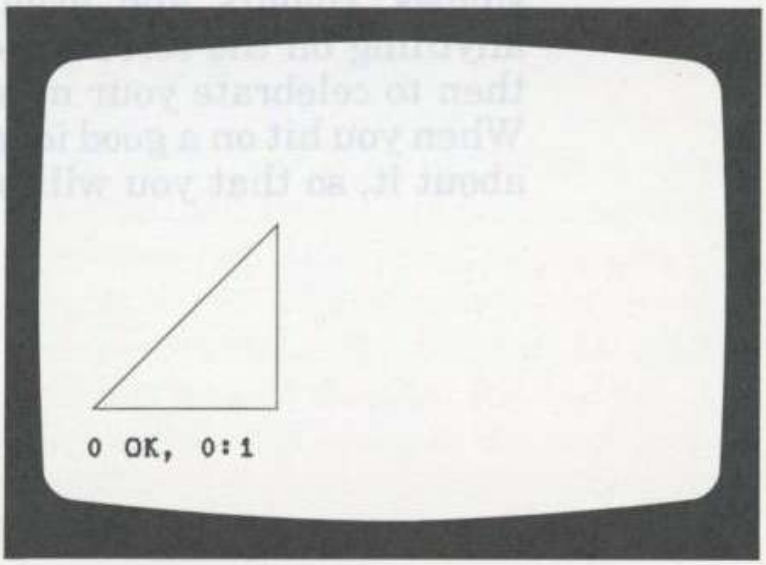
This is what will appear on the screen:



You try

Press NEW then ENTER.
Type DRAW 255,175
then press ENTER.

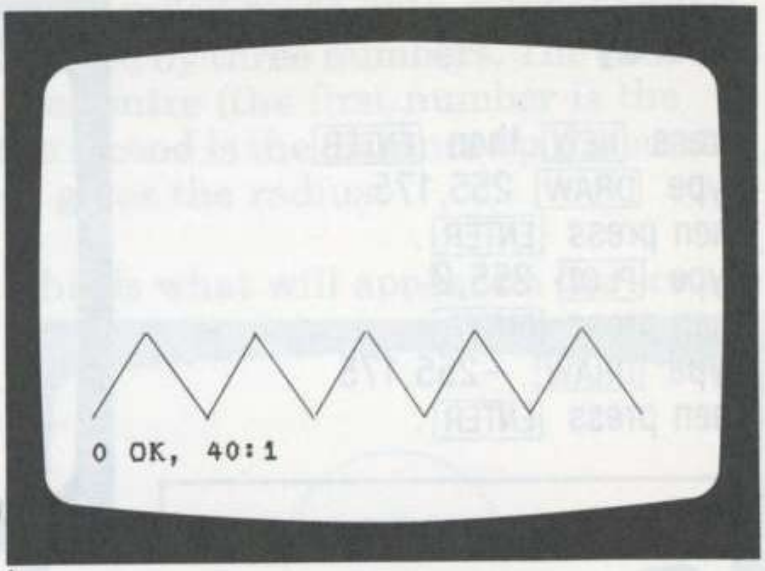
This is what will appear on the screen:



You try

Press NEW then ENTER.
Type DRAW 1ØØ,Ø
then press ENTER.
Type DRAW Ø,1ØØ
then press ENTER.
Type DRAW -1ØØ,-1ØØ
then press ENTER.

This is what will appear on the screen:



You try

Press NEW then ENTER.
Type in the following program.
10 FOR n=1 TO 5
20 DRAW 25,25
30 DRAW 25,−25
40 NEXT n
Press RUN then ENTER.

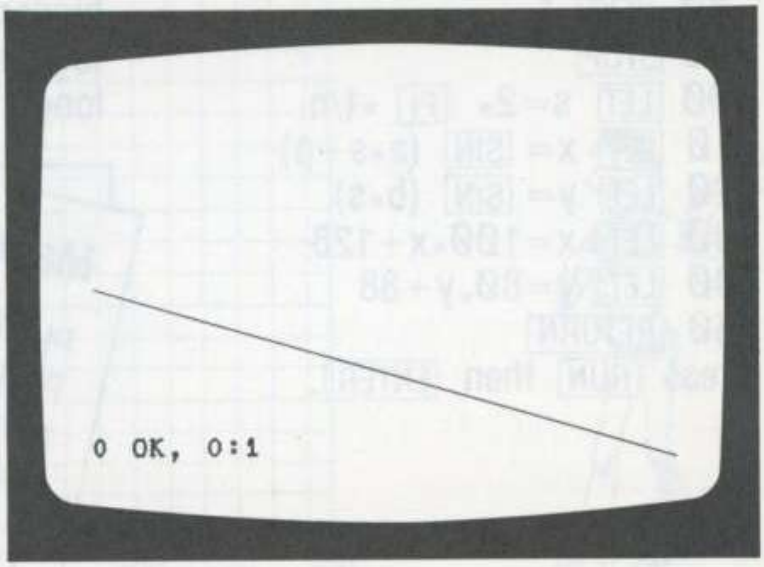
Make a note

DRAW is on key W.
DRAW must be followed by two numbers separated by a comma. The first number must be between −255 and 255. The second number must be between −175 and 175.

Plotting on the screen

PLOT (on key Q) is used to move on the screen without drawing a line and also to make a small dot.
When using DRAW you will find sometimes that you need to move to another point on the screen without drawing a line. This can be done using PLOT. PLOT must be followed by two numbers separated by a comma. The first number gives the distance across, and the second number gives the distance up the screen that a dot is placed. Any line using DRAW will be drawn from this dot.

This is what will appear on the screen:

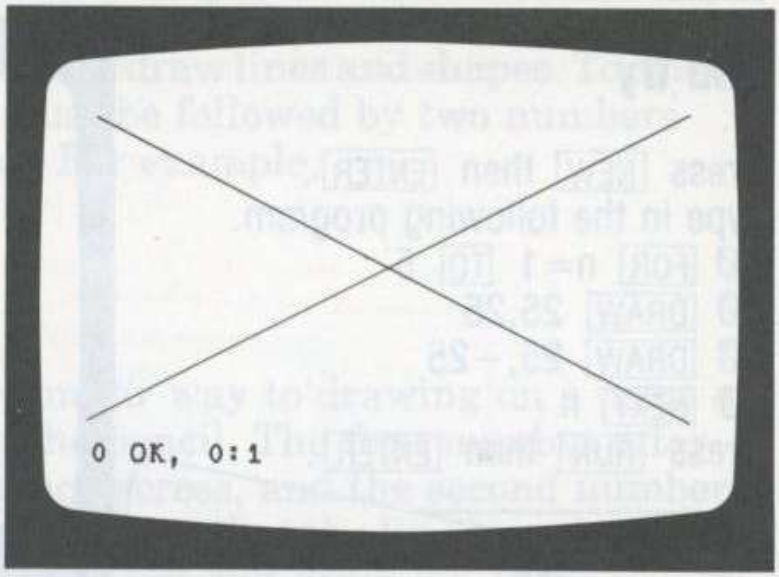


You try

Press NEW then ENTER.
Type PLOT 0,100
then press ENTER.
Type DRAW 255,−100
then press ENTER.

You try

Press NEW then ENTER.
Type DRAW 255,175
then press ENTER.
Type PLOT 255,Ø
then press ENTER.
Type DRAW −255,175
then press ENTER.



The next 'You try' shows how PLOT can be used to draw some pretty curves called Lissajous' curves. The program uses PI (on key M in extended mode) and SIN (on key Q in extended mode). You can use the program even if you do not know about PI and SIN.

You try

Press NEW then ENTER.
Type in the following program.

```
 1Ø LET n=5ØØ
 2Ø LET a=5: LET b=7
 3Ø LET p=6
 4Ø LET p=p* PI /12
 5Ø FOR t=Ø TO n
 6Ø GOSUB 1ØØ
 7Ø PLOT x,y
 8Ø NEXT t
 9Ø STOP
1ØØ LET s=2* PI *t/n
11Ø LET x= SIN (a*s+p)
12Ø LET y= SIN (b*s)
13Ø LET x=1ØØ*x+128
14Ø LET y=8Ø*y+88
15Ø RETURN
```

Press RUN then ENTER.

You try

Change line 2Ø to
2Ø LET a=1: LET b=1
and run the program again.
Put other values for a and b in line 2Ø and see what other curves you can make. You can also try changing the value of p in line 3Ø.
The value of n in line 1Ø gives the number of dots. If you make n bigger, the dots will be closer together and the curve will take longer to draw.

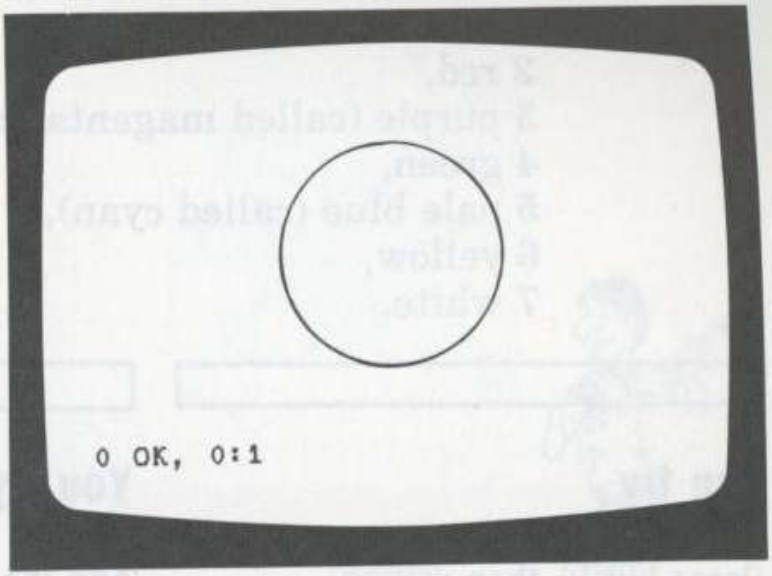
Make a note

PLOT is on key Q.
PLOT must be followed by two numbers separated by a comma.
The first number must be between Ø and 255.
The second number must be between Ø and 175.

Circles on the screen

CIRCLE (on key H in extended mode with symbol shift) draws a circle. It is followed by three numbers. The first two give the position of the centre (the first number is the distance across and the second is the distance up the screen), and the third number gives the radius.

This is what will appear on the screen:



You try

Press NEW then ENTER.
Type CIRCLE 125,85,5Ø
then press ENTER.

You try

Press NEW then ENTER.
Type in the following program.

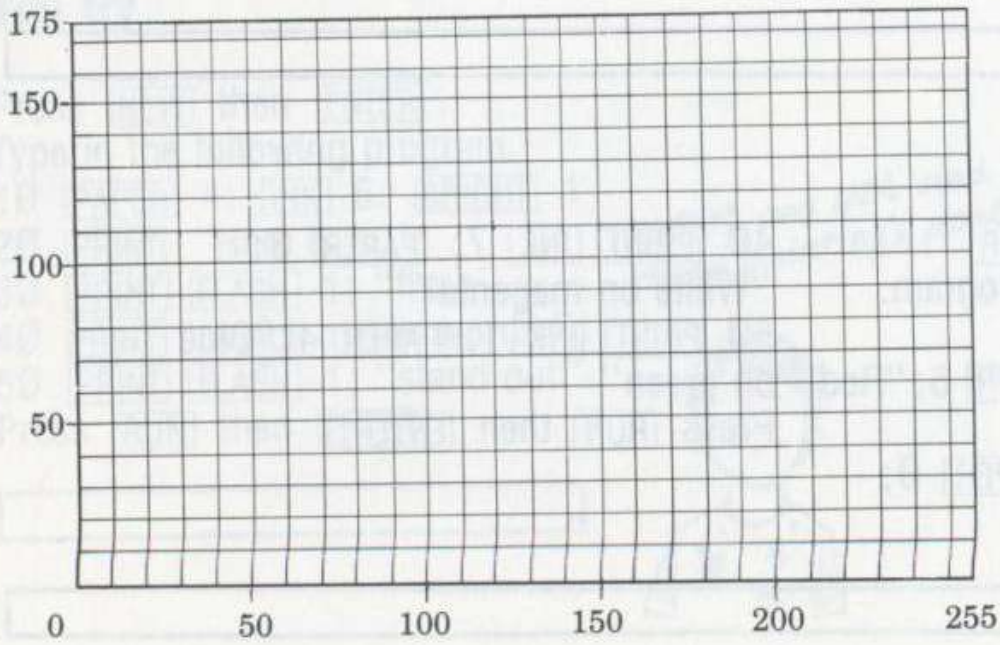
```
1Ø FOR r=1Ø TO 8Ø STEP 1Ø
2Ø CIRCLE 125,85,r
3Ø NEXT r
```

Press RUN then ENTER.

You try

Use DRAW, PLOT and CIRCLE to draw a house or a person.

To help you plan your drawings, here is a grid giving distances across and up the screen.



Changing colours

The colour of characters is given by INK (on key X in extended mode with symbol shift), the background colour is given by PAPER (on key C in extended mode with symbol shift) and the colour of the edge of the screen or border is given by BORDER (on key B). The colours with their codes are

0 black,
1 blue,
2 red,
3 purple (called magenta on the computer),
4 green,
5 pale blue (called cyan),
6 yellow,
7 white.

You try

Press [NEW] then [ENTER].
Type in the following program.
1Ø [BORDER] 3
2Ø [INK] 6
3Ø [PAPER] 2
4Ø [PRINT] "Yellow on red"
5Ø [CIRCLE] 2ØØ,1ØØ,4Ø
Press [RUN] then [ENTER].

You try

Add the line
35 [CLS]
to the last program and see what happens.

INK and PAPER can be used inside PRINT statements so that they apply just to that line.

You try

Press [NEW] then [ENTER].
Type in the following program.
1Ø [BORDER] 1
2Ø [PRINT] [INK] 2; [PAPER] 6; "Red on yellow"
3Ø [PRINT] [INK] 5; [PAPER] Ø; "Cyan on black"
4Ø [PRINT] [INK] 7; [PAPER] 3; "White on magenta"
5Ø [PRINT] [INK] 1; [PAPER] 4; "Blue on green"
Press [RUN] then [ENTER].

WARNING! If your INK colour and PAPER colour are the same, you will not be able to read what is on the screen.

BRIGHT (on key B in extended mode with symbol shift) is used to make colours brighter. BRIGHT 1 turns the brightness on and BRIGHT Ø turns it off again. BRIGHT can be put after PRINT so that it applies just to that line.

You try

Press NEW then ENTER.
Type in the following program.

```
1Ø BORDER Ø
2Ø FOR c=1 TO 7
3Ø PAPER c
4Ø PRINT "normal",,
5Ø PRINT BRIGHT 1; "bright",,
6Ø PRINT PAPER Ø,,
7Ø NEXT c
8Ø PRINT "These are the colours."
```

Press RUN then ENTER.

FLASH on (key V in extended mode with symbol shift) is used to make characters flash. FLASH 1 turns the flashing on and FLASH Ø turns it off again. FLASH can also be used with PRINT.

You try

Press NEW then ENTER.
Type in the following program.

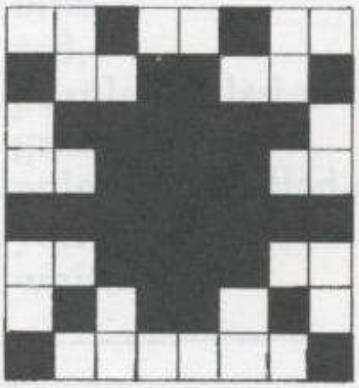
```
1Ø PAPER 4: INK 6: BRIGHT 1
2Ø PRINT "Here is a ";
3Ø PRINT FLASH 1; "flash"
4Ø PRINT "which makes words ";
5Ø PRINT FLASH 1; "stand out"
```

Press RUN then ENTER.

PAPER and INK and FLASH and BRIGHT mean painting's done at the speed of light

User-defined graphics

In the keyboard section you learnt about the graphics characters on the number keys. You are now going to learn how to design your own characters. First you need to make up your design on a grid which is 8 squares by 8 squares. For example, here is a beetle.



We shall tell the computer about our design a row at a time, using Ø for a white square and 1 for a black square. BIN (on key B in extended mode) is used to tell the computer that the number is in binary, which means that it just uses Ø and 1. The next 'You try' also uses the commands POKE (on key O) and USR (on key L in extended mode). POKE is used to put each row into a special place in the computer's memory. USR is used to say that the letter following USR is the special place.

You try

Press NEW then ENTER.
Type in the following program.

```
1Ø DATA BIN ØØ1ØØ1ØØ
2Ø DATA BIN 1ØØ11ØØ1
3Ø DATA BIN Ø1111111Ø
4Ø DATA BIN ØØ111100
5Ø DATA BIN 11111111
6Ø DATA BIN ØØ111100
7Ø DATA BIN Ø1Ø11Ø1Ø
8Ø DATA BIN 1ØØØØØØ1
1ØØ FOR n=Ø TO 7
11Ø READ row
12Ø POKE USR "b"+n,row
13Ø NEXT n
```

Press RUN then ENTER.
Nothing exciting will appear on the screen yet.
Now go into graphics mode (hold down CAPS SHIFT and press 9) and then type B.

You try

Design your own graphics character on a grid. Change the first eight lines of the last program to give the new rows.
Change line 12Ø to
12Ø [POKE] [USR] "a"+n,row
Run your new program.
Go into graphics mode and type A to see your character.

It is useful to be able to tell the computer where to print a character. To do this use AT (on key I with symbol shift) after PRINT and follow it by two numbers to give the row and column. For example,
PRINT AT 1Ø,2Ø; "X"
will print a cross in the 1Øth row and 2Øth column.

You try

Press [NEW] then [ENTER].
Type in the following program which is a first attempt to make the beetle walk up the screen.
1Ø [FOR] r=21 [TO] Ø [STEP] −1
2Ø [PRINT] [AT] r,1Ø; "▚"
3Ø [NEXT] r
Press [RUN] then [ENTER].

NEW rubs out the old program, but leaves the user defined graphics unharmed.

▚ is produced by going into graphics mode and typing B. Remember to come out of graphics mode afterwards.
This program leaves a line of beetles. To make it look as if one beetle is walking up the screen, another program line is needed which puts a space in the row r+1 and wipes away the beetle there.

You try

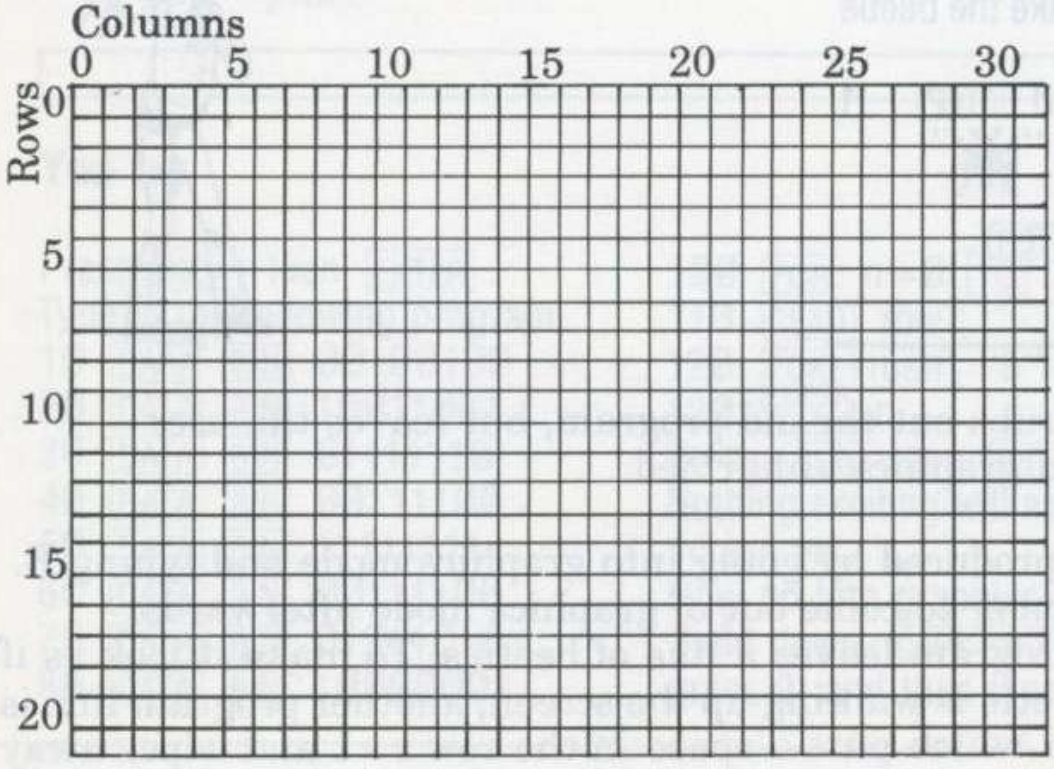
Add this line to the last program.
25 IF r<21 THEN PRINT AT r+1,10;" "
Now run the program again.

The beetle may be going too fast for you so you could add the line
27 PAUSE 5
Make the beetle go faster or slower by making the number after PAUSE smaller or bigger.

You try

Design your own creature and make it move around the screen. Also try adding colour. To help you plan moving your creature, a grid showing rows and columns is given below.

Graphics are fun
When the Beetles run



Making music

BEEP (on key Z in extended mode with symbol shift) is used to play musical notes. BEEP is followed by two numbers separated by a comma. The first number gives the number of seconds the note is played. The second number selects how high or low the note is (called the pitch).

You try

Type [BEEP] 2,Ø
This plays a long low note.

You try

Type [BEEP] .5,2Ø
This plays a short, high note.

You try

Use BEEP to play some notes of your own.

The next 'You try' shows how high the notes can go. See if you can hear them all.

You try

Type in the following program.
1Ø [FOR] n=Ø [TO] 69
2Ø [BEEP] .5,n
3Ø [NEXT] n
Press [RUN] then [ENTER].

You try

Use BEEP to compose a short tune.

You try

Change the last 'You try' by adding '[STEP] .1' to the end of line 1Ø and changing the length of the note from .5 to .Ø1 in line 2Ø. Now run the program again.
Try making your own changes to the program.

Make a note

BEEP must be followed by two numbers separated by a comma.
The first number gives the length of the note.
The second number gives the pitch.

Project 4 – Patterns

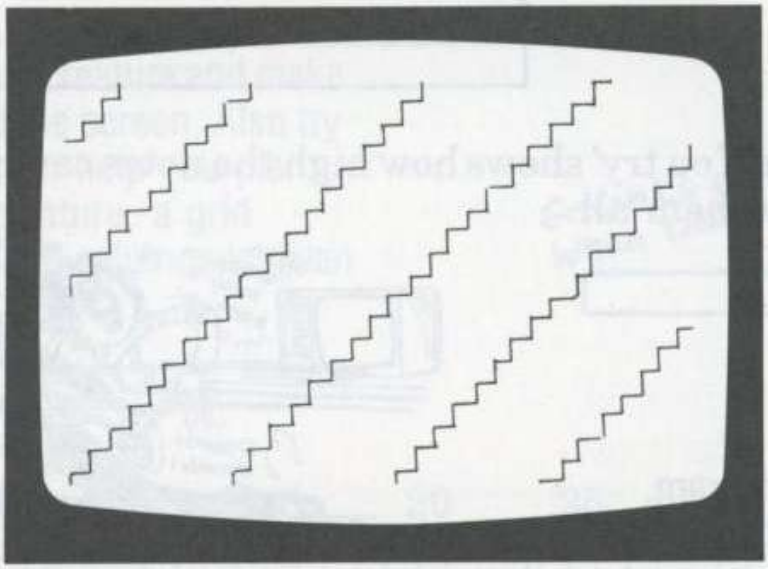
In this project we shall use a simple program to make some patterns on the screen. The program will become more complicated as we go on. Type in the following lines:

```
1ØØ FOR y=Ø TO 2Ø
11Ø FOR x=Ø TO 3Ø
2ØØ PRINT AT y,x; PAPER p; " ";
25Ø NEXT x
26Ø NEXT y
```

The gaps in the numbering are for extra lines we shall add. Perhaps you can see how this program works: x counts across the page, y down the page, and line 2ØØ prints at the point y,x a space in the colour p. Of course, by itself this program will not work as we have not told the computer what p is. Add the line:

```
12Ø LET p=(x+y)/8
```

and RUN the program.
You will have stripes of colour going across the screen:



Try it again with:

```
12Ø LET p=(x-y+2Ø)/7
```

instead. You may like to try it with your own expressions for p in line 12Ø. Invent a few. If you do you may get error messages like:

B Integer out of range, 2ØØ:1
or K Invalid colour, 2ØØ:1

This is because the number p sometimes becomes either less than Ø or more than 9. For example, this happens if you try

```
12Ø LET p=x+y
```

It is a nuisance to have to design an expression for p carefully so that it always gives an answer between Ø and 9. Instead we can make p any expression, and then replace it if it is too large or too small.

A. One way to do this is to add the line:
13Ø LET p=p−7∗ INT (p/7)
The useful expression p−7∗ INT (p/7) gives the remainder when p is divided by 7. Try this with:
12Ø LET p=x+y and other expressions in line 12Ø such as:
x∗x, x∗y, x−y, x∗x + y∗y, 7∗y/(x+1).
Try some expressions of your own. Make a note of any you particularly like so that you can use them later.

B. One way to change the program is to use a graphics character in place of the space in line 2ØØ. For example, try EDITing 2ØØ to:
2ØØ PRINT AT y,x; PAPER p; "▚";
using the graphics character on key 6. Try this with one of the expressions such as:
12Ø LET p=(x+y)/5
Try it with other graphics characters and other expressions. You can try adding INK q to line 2ØØ and giving an expression for q in line 14Ø and adding the line:
15Ø LET q=q−7∗ INT (q/7)

C. Going back to having the original line 2ØØ, a complicated expression to try in line 12Ø is:
12Ø LET p= ((y−1Ø)∗(y−1Ø) + (x−15)∗(x−15))/2Ø
Try EDITing this line to be
12Ø LET p=((y−1Ø)∗(y−1Ø)/4 + (x−15)∗(x−15)/5)/2Ø
and see what happens. Try changing the numbers 4, 5 and 2Ø.
Another expression to try is:
12Ø LET p= (x−15)∗(y−1Ø)/1Ø
or similar expressions but with numbers other than 1Ø at the end.

D. You may like to make the colours come in a different order, such as:
black, red, magenta, blue, cyan, green, yellow, white.
To do this change line 2ØØ to be:
2ØØ PRINT AT y,x; PAPER a(p); " ";
Now we must tell the computer what values a(p) has. It will have one for each possible p, where p will be 1,2,3,4,5,6,7 or 8. Do this by adding the lines:
2Ø FOR i=1 TO 8
3Ø READ a(i)
4Ø NEXT i
5Ø DATA Ø,2,3,1,5,4,6,7

The numbers in line 5Ø correspond to the order of the colours. We need to warn the computer how many of a(i) there will be so we must add the line:

```
1Ø DIM a(8)
```

to show that there will be eight of them.
The computer likes to start at a(1) rather than at a(Ø) so line 2ØØ must be changed to:

```
2ØØ PRINT AT y,x; PAPER a(p+1);"  ";
```

Now RUN the program with different expressions in line 12Ø. The values for a(i) you have been using make up an array. You can read more about arrays in Chapter 12 of the Spectrum manual.

Project 5 – Making pictures

This project will provide you with subroutines which you can use to build up pictures of your own.
The first subroutine can be used to give the background colour of the bottom part of the screen from a certain row (called w) downwards. Before using the subroutine you need to give the colour using PAPER (and BRIGHT if you wish), and to give the value of w using LET.

```
5ØØ FOR i=w TO 21
51Ø FOR j=Ø TO 31
52Ø PRINT AT i,j;"  ";
53Ø NEXT j
54Ø NEXT i
55Ø RETURN
```

The second subroutine will draw a disc with centre distance x across the screen and distance y up the screen, and radius r. Before using the subroutine you need to give the colour using INK (and BRIGHT if you wish) and to give the values of x, y and r using LET.

```
6ØØ FOR k=1 TO r
61Ø CIRCLE x,y,k
62Ø NEXT k
63Ø RETURN
```

The third subroutine will draw a rectangle which goes a distance b across the screen and a distance h up the screen. Before using the subroutine you need to give the colour using INK (and BRIGHT if you wish), to use PLOT to make a dot where you want the bottom left-hand corner to be, and to give the values of b and h using LET.

```
7ØØ DRAW b,Ø
```

```
71Ø FOR m=1 TO h
72Ø DRAW -b,1
73Ø DRAW b,Ø
74Ø NEXT m
75Ø RETURN
```

Here is a sample program to show you how these subroutines can be put together. First let us make the border black and the main background colour blue by:

```
1Ø BORDER Ø
2Ø PAPER 1: CLS
```

We make the screen bright green from row 16 downwards by

```
3Ø PAPER 4: BRIGHT 1
4Ø LET w=16: GOSUB 5ØØ
```

We make a bright yellow sun in the sky by

```
5Ø INK 6
6Ø LET x=2ØØ: LET y=13Ø: LET r=2Ø
7Ø GOSUB 6ØØ
```

Now we draw a red car. Notice how the brightness is turned off by BRIGHT Ø, and that we do not need to give y and r a second time if they are staying unchanged.

```
8Ø INK 2: BRIGHT Ø
9Ø LET b=5Ø: LET h=1Ø
1ØØ PLOT 1ØØ,55: GOSUB 7ØØ
11Ø LET b=3Ø: LET h=15
12Ø PLOT 1Ø2,65: GOSUB 7ØØ
13Ø LET x=11Ø: LET y=5Ø: LET r=8
14Ø GOSUB 6ØØ
15Ø LET x=14Ø
16Ø GOSUB 6ØØ
```

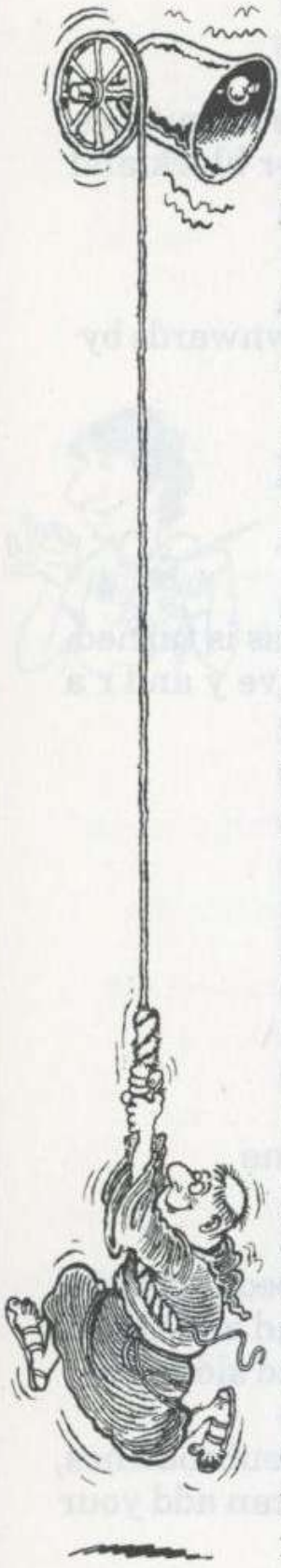
Now that we have finished we must add the line

```
17Ø STOP
```

Make sure that you have all the subroutines typed in as well and then RUN the program. Try using the second and third subroutines to make a tree to add to the left-hand side of the picture.

Now you can make pictures of your own with the subroutines, using the grid on page 76 to help you plan. You can add your own user-defined graphics if you wish.

Project 6 – Music



The object of this program is to play the tune Brother Joseph (Frère Jacques). The English words, with notes above, are given below.

```
  G  A  B  G     G  A  B  G
Brother Joseph, Brother Joseph,
  B   C' D'   B   C'  D'
Wake up now! Wake up now!
D' E' D' C' B  G   D' E' D' C' B  G
Go and pull the bell rope. Go and pull the bell rope.
  G    D    G     G    D    G
Ding, dang, dong. Ding, dang, dong.
```

Each note can be given to the computer as a command of the form BEEP time, pitch. Time gives the length of the note and pitch says how high or low it is. The numbers for the pitch are

D	E	F	G	A	B	C'	D'	E'
2	4	5	7	9	11	12	14	16

The time should be .5 for the short notes, 1 for the medium length notes, and 2 for the long notes. If you find it difficult to decide on the timing, put the time to be 1 for all the notes at first, and make changes after listening.
Some suggestions for writing this program are given below. You may find them useful.

A. LET t=1 at the beginning of the program and then let the time be given as t/2, t or 2*t as appropriate (rather than .5,1 or 2). Then the speed at which the tune is played can be changed easily, by changing the value of t. The value of t gives the length of a beat.

B. It is a good idea to use DATA/READ in a similar way to the Knock, knock project. This is a better way to program and needs less typing. It also makes it easier to change the key in which the tune is played, that is to play the whole tune higher or lower.

C. You could make the words come up on the screen as the tune is being played by using PRINT. This could also help to make it easier to see where in the tune you have reached when you LIST the program.

FINDING OUT

Miss O. C. Termup

My advice

Always check the terms you use just as you would check the meaning of unusual words with a dictionary. Most of the terms are fairly easy to understand, but there are a lot of them. If you are unsure then check the meaning and use. The reference section is in two parts. The first gives the commands and functions and the second gives the special symbols you are likely to need. It would be very useful if you made your own reference book to contain all the terms and symbols you come across.

Olive C. Termup

Reference section

The terms which you have used in the book will all be found in the reference section, but you will also find some new terms. These are included because they may be useful when you are writing your own programs.
The reference section gives only a brief outline of the meaning and use of the terms and if you wish to find out more about them you will have to look them up in other books. The list below is given for this purpose.

ZX Spectrum manual
Author: Steven Vickers
Sinclair Research

Over the Spectrum
Editor: Philip Williams
Melbourne House Publishers
ISBN 0 86759 112 9

The Spectrum Pocket Book
Author: Trevor Toms
Phipps Associates
ISBN 0950 7302 8 9

There are also a number of computer magazines which can be very helpful. Quite regularly they list programs which you might find interesting and you may well be able to adapt these programs to your own needs. Some suitable magazines are:

ZX Computing
Your Computer
Sinclair User

Commands and functions

Here is a list of all the terms that the ZX Spectrum understands. The ones in heavy type are those which are most likely to be useful to you. These are the ones described more fully in the following pages. Wait to use the other terms until you have learnt more about the computer language BASIC.

ABS
ACS
AND
ASN
AT
ATN
ATTR
BEEP
BIN
BORDER
BREAK
BRIGHT
CAPS LOCK
CAPS SHIFT
CAT
CHR$
CIRCLE
CLEAR
CLOSE#
CLS
CODE
CONTINUE
COPY
COS
DATA
DEF FN
DELETE
DIM
DRAW
EDIT
ENTER
ERASE
EXP
FLASH
FN
FOR
FORMAT
GO SUB
GO TO
GRAPHICS
IF
IN
INK
INKEY$
INPUT
INT
INVERSE
LEN
LET
LINE
LIST
LLIST
LN
LOAD
LPRINT
MERGE
MOVE
NEW
NEXT
NOT
OPEN#
OR
OUT
OVER
PAPER
PAUSE
PEEK
PI
PLOT
POINT
POKE
PRINT
RAND
READ
REM
RESTORE
RETURN
RND
RUN
SAVE
SCREEN$
SGN
SIN
SPACE
SQR
STEP
STOP
STR$
SYMBOL SHIFT
TAB
TAN
THEN
TO
USR
VAL
VAL$
VERIFY

ABS key G [E] mode

ABS gives the positive value of a number.

[PRINT] [ABS] (−7) gives 7 on the screen.

Spectrum manual page 59

ACS key W [E] mode with symbol shift

ACS gives the angle whose cosine is known (in radians), that is arc-cosine.

Spectrum manual page 70

AND key Y with symbol shift

AND is used to check whether two conditions hold.

[IF] x> = Ø [AND] <1Ø [THEN] # [PRINT] "digit"

See page 53

Spectrum manual page 85

ASN key Q [E] mode with symbol shift

ASN gives the angle whose sine is known (in radians), that is arc-sine.

Spectrum manual page 70

AT key I with symbol shift

AT is used with PRINT or INPUT to tell the computer where to print on the screen.

[PRINT] [AT] 5,9; "£" prints £ in the fifth row down and ninth column across.

See page 73

Spectrum manual page 101

ATN key E [E] mode with symbol shift

ATN gives the angle whose tangent is known (in radians), that is arc-tan.

Spectrum manual page 70

BEEP key Z [E] mode with symbol shift

BEEP is used to play a note.

[BEEP] 1,4 plays a note for one second which is four semitones higher than middle C.

See page 75

Spectrum manual page 135

BIN key B [E] mode

BIN tells the computer that the following number is written in binary, that is just using Ø and 1.

[PRINT] [BIN] 1Ø1 gives the number 5 on the screen.

See page 72

Spectrum manual page 217

BORDER key B

BORDER followed by a number changes the colour of the border of the screen.

BORDER Ø gives a black border on the screen.

See page 70

Spectrum manual page 113

BREAK SPACE key with caps shift

BREAK stops the computer when it is running a program.

Spectrum manual page 19

BRIGHT key B [E] mode with symbol shift

BRIGHT 1 makes colours brighter.

See page 71

Spectrum manual page 110

CAPS LOCK key 2 with caps shift

When CAPS LOCK has been pressed all letters are read as capitals.

See page 9

Spectrum manual page 8

CAPS SHIFT

When CAPS SHIFT is held down letters are printed as capitals.

See page 9

Spectrum manual page 7

CIRCLE key H [E] mode with symbol shift

CIRCLE 5Ø,1ØØ,3Ø draws a circle with centre a distance of 5Ø across and 1ØØ up, and with radius 3Ø.

See page 69

Spectrum manual page 123

CLS key V

CLS clears the screen.

Spectrum manual page 103

CONTINUE key C

CONTINUE is used to start a program running again from where it was stopped when BREAK has been pressed.

Spectrum manual page 19

COS key W [E] mode

COS gives the cosine of an angle (the angle must be given in radians).

Spectrum manual page 67

DATA key D [E] mode

DATA is used with READ to supply data for a program.

[DATA] 1,2,3,4,5

[DATA] "apple", "banana", "carrot", "date"

See page 48

Spectrum manual page 41

DELETE key Ø with caps shift

DELETE rubs out the character to the left of the cursor.

See page 9

Spectrum manual page 8

DIM key D

DIM allows groups of words or numbers to be put into the computer.

[DIM] x (1Ø) allows numbers to be put into the computer with addresses x(1), x(2), x(3) . . . up to x(1Ø).

Spectrum manual page 79

DRAW key W

DRAW draws a line on the screen.

[DRAW] 3Ø,4Ø draws a straight line going to a point 3Ø across the screen and 4Ø up the screen.

See page 66

Spectrum manual page 121

EDIT key 1 with caps shift

EDIT brings a line in a program to the bottom of the screen so that it can be changed.

See page 13

Spectrum manual page 14

ENTER

ENTER makes the computer read the line you have just typed.

See page 9

Spectrum manual page 8

EXP key X [E] mode

EXP gives e (2.7183) to any power.

Spectrum manual page 65

FLASH Key V [E] mode with symbol shift

[FLASH] 1 makes characters flash.

See page 71 Spectrum manual page 110

FOR key F

FOR is used with TO and NEXT to repeat the same lines many times.

[FOR] x=Ø [TO] 1Ø: [PRINT] x: [NEXT] x

gives x the values Ø,1,2 . . . 1Ø on the screen.

See page 47 Spectrum manual page 31

GOSUB key H

GOSUB is an instruction to go to a subroutine which starts at the line number which follows it. RETURN is used at the end of the subroutine.

See page 58 Spectrum manual page 37

GOTO key G

GOTO is an instruction to go to a particular line.

[GOTO] 41Ø tells the computer to go to line 41Ø.

See page 51 Spectrum manual page 16

GRAPHICS key 9 with caps shift

When GRAPHICS has been pressed the number keys give graphics characters.

See page 9 Spectrum manual page 91

IF key U

IF is used with THEN to check if a condition holds.

[IF] a$ = "good" [THEN] [PRINT] "I am "; a$

See page 49 Spectrum manual page 25

INK key X [E] mode with symbol shift

INK changes the colour of characters when followed by a number between Ø and 7.

See page 70 Spectrum manual page 109

INKEY$ key N [E] mode

INKEY$ reads the key currently being pressed (if any).

Spectrum manual page 131

INPUT key I

INPUT allows words or numbers to be put into the computer.
[INPUT] a (for numbers)
[INPUT] a$ (for words)
See pages 31 and 43
Spectrum manual page 16

INT key R [E] mode

INT gives the integer (or whole number) part of a number.
[PRINT] [INT] 45.61 gives 45 on the screen.
[PRINT] [INT] −17.22 gives −18 on the screen.
See page 55
Spectrum manual page 59

INVERSE key M [E] mode with symbol shift

[INVERSE] 1 swaps over the paper and ink colours.
Spectrum manual page 112

LEN key K [E] mode

LEN gives the number of characters in a word.
[PRINT] [LEN] "Termup" would print 6.
See page 56
Spectrum manual page 57

LET key L

LET is used to give a value or word.
[LET] b=8 (for numbers)
[LET] b$="cat" (for words)
See pages 29 and 41
Spectrum manual page 13

LIST key K

LIST lists a program.
[LIST] lists the whole program.
[LIST] 2Ø lists the program from line 2Ø onwards.
Spectrum manual page 15

LN key Z [E] mode

LN gives logarithms of numbers to base e (2.7183).
Spectrum manual page 67

LOAD key J

LOAD loads a program from a cassette.
[LOAD] "water" will load the program called 'water'.
Spectrum manual page 141

MERGE key T [E] mode with symbol shift

MERGE loads a program from a cassette without losing any program that is already in the computer's memory (unless line numbers are repeated).

Spectrum manual page 147

NEW key A

NEW sets up the computer for a new program to be typed in (it removes any existing program).

See pages 16 and 73

Spectrum manual page 16

NEXT key N

NEXT is used with FOR and TO.

See page 47

Spectrum manual page 31

NOT key S with symbol shift

NOT a=b means that 'a does not equal b'.

Spectrum manual page 85

OR key U with symbol shift

OR is used to check whether one of two conditions holds. [IF] a=3 [OR] b=6 [THEN] [PRINT] "yes" will print 'yes' if either a=3 or b=3 (or both a=3 and b=6).

See page 54

Spectrum manual page 85

OVER key N [E] mode with symbol shift

[OVER] 1 makes PRINT put characters on top of anything already there.

Spectrum manual page 113

PAPER key C [E] mode with symbol shift

PAPER followed by a number changes the background colour. See page 70

Spectrum manual page 109

PAUSE key M

[PAUSE] 5Ø makes the computer stop for about a second.

See page 74

Spectrum manual page 129

PI key M [E] mode

PI=3.1415927. The circumference of a circle of radius r is 2*PI *r.

[PRINT] [PI] gives 3.1415927 on the screen.

Spectrum manual page 67

PLOT key Q

PLOT is used to make a dot and to start to draw from a particular point.

[PLOT] 1ØØ,12Ø makes a dot at a distance 1ØØ across the screen and 12Ø up the screen.

See page 67

Spectrum manual page 121

POKE key O

POKE is used to store a number at a particular place in the computer's memory.

See page 72

Spectrum manual page 94

PRINT key P

Numbers can be printed using PRINT 5.

Words can be printed using PRINT "alphabet".

[PRINT] 5,6 gives 5 6

[PRINT] 5;6 gives 56

[PRINT] 5'6 gives 5
6

See pages 22 and 39

Spectrum manual page 13

RAND key T

RAND is short for RANDOMISE. When used on its own it makes sure that the random numbers given by RND are different each time you run the program.

Spectrum manual page 73

READ key A [E] mode

READ is used with DATA to read information.

1Ø [READ] a$,b$,c$,d$
2Ø [DATA] "red","green","orange","blue"
3Ø [PRINT] b$

prints 'green'.

See page 48

Spectrum manual page 41

REM key E

REM is used for putting a comment or REMark into a program. The computer ignores any writing following REM.

See page 12

Spectrum manual page 16

RESTORE key S [E] mode

RESTORE is used before READ to say which line the data should be taken from. [RESTORE] 2ØØ means take the next data from line 2ØØ.

Spectrum manual page 42

RETURN key Y

RETURN is used at the end of a subroutine to go back to the main part of the program.

See page 58

Spectrum manual page 37

RND key T [E] mode

RND gives a random numberr between Ø and 1.
The following program chooses one of the numbers Ø,1,2,3,4 at random twenty times.

```
1Ø [FOR] k = 1 [TO] 2Ø
2Ø [PRINT] [INT] (5* [RND])
3Ø [NEXT] k
```

See page 55

Spectrum manual page 73

RUN key R

RUN asks the computer to run through a program.

See page 36

Spectrum manual page 14

SAVE key S

SAVE records a program on a cassette.
[SAVE] "missile" saves a program and calls it 'missile'.

Spectrum manual page 141

SGN key F [E] mode

SGN gives the sign of a number.
1 for positive
−1 for negative
Ø for zero

Spectrum manual page 59

SIN key Q [E] mode

SIN gives the sine of an angle (the angle must be given in radians).

Spectrum manual page 67

SPACE

SPACE is used to make a space between words.

See page 9

Spectrum manual page 8

SQR key H [E] mode

SQR gives the square root of a number.

[PRINT] [SQR] (16) prints 4.

Spectrum manual page 60

STEP key D with symbol shift

STEP is used with FOR and TO.

[FOR] x=1 [TO] 11 [STEP] 2: [PRINT] x: [NEXT] x

gives x the values 1,3,5,7,9,11 on the screen.

See page 47

Spectrum manual page 32

STOP key A with symbol shift

STOP ends the running of a program.

See pages 38 and 58

Spectrum manual page 25

SYMBOL SHIFT

SYMBOL SHIFT is used to give the symbols and words in red which are on or below the keys.

See page 9

Spectrum manual page 7

TAB key P [E] mode

TAB is used to print from a particular column.

[PRINT] [TAB] 10; "+" will print a '+' in the tenth column.

See page 40

Spectrum manual page 103

TAN key E [E] mode

TAN gives the tangent of an angle (the angle must be given in radians).

Spectrum manual page 67

THEN key G with symbol shift

THEN is used with IF.

[IF] x=1Ø [THEN] [GOTO] 6ØØ

See page 49

Spectrum manual page 25

TO key F with symbol shift

TO is used with FOR and NEXT.

See page 47 Spectrum manual page 32

USR key L [E] mode

USR is used when defining user-defined graphics.

See page 72 Spectrum manual page 93

VERIFY key R [E] mode with symbol shift

VERIFY is used to check whether a program has been saved on a cassette correctly.

Spectrum manual page 141

Special symbols

$ key 4 with symbol shift

$ is used after a letter to give a name for a word.

See page 28 Spectrum manual page 18

' key 7 with symbol shift

' is used with PRINT to give a new line.

See page 24 Spectrum manual page 17

← key 5 with caps shift

← is used to move the cursor left along a line being edited.

See page 13

↓ key 6 with caps shift

↓ is used to move the line pointer (which looks like > down a line.

See page 13 Spectrum manual page 8

key 7 with caps shift

↑ is used to move the line pointer (which looks like >) up a line.

See page 13

Spectrum manual page 8

key 8 with caps shift

→ is used to move the cursor right along the line being edited.

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<= key Q with symbol shift

<= means 'is less than or equal to'. For example, 1 <=2, 1 <=1.

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<> key W with symbol shift

means 'is not equal to'.

Spectrum manual page 25

>= key E with symbol shift

>= means 'is greater than or equal to'. For example, 4>=2, 4>=4.

Spectrum manual page 25

< key R with symbol shift

< means 'is less than'. 1<2 is true, but 2<2 is not.

Spectrum manual page 25

> key T with symbol shift

> means 'is greater than'. 6>3 is true, but 3>3 is not.

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; key O with symbol shift

; is used with PRINT to make the printing carry on without leaving any spaces.

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" key P with symbol shift

" is used at the start and finish of a word or group of words that the computer is to store or print.

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↑ key H with symbol shift

5↑2 means 5*5 and is usually written 5^2.

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– key J with symbol shift

– is the sign for subtract or take away.

+ key K with symbol shift

+ is the sign for add.

= key L with symbol shift

= means 'equals'.

: key Z with symbol shift

: is used between commands so that more than one can be written on a line.

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/ key V with symbol shift

/ is the sign for divide or share.

* key B with symbol shift

* is the sign for multiply or times.

, key N with symbol shift

, is used with PRINT to space out words or numbers.

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. key M with symbol shift

. is used as a decimal point.

Redbridge Teachers' Centre

A child's guide to the ZX SPECTRUM

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